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ABSTRACT

Nine papers from the 1988 CAUSE conference's Track II, Managing Technologies Integration, are presented. They include: "Computing in the '90s--Will We Be Ready for the Applications Needed?" (Stephen Patrick); "Glasnost, The Era of 'Openness'" (Bernard W. Gleason); "Academic and Administrative Computing: Are They Really Merging?" (Samuel J. Plice); "Computer-Aided Software Engineering (CASE): Don't Jump on the Bandwagon Unless You Know the Parade Route" (David Smithers); "CASE: Environment, Experiences, Expectations" (Margaret V. Krol and Jeffrey J. Tyler); "Telecommunications as the Umbrella for Managing the Linkage and Integration of Resources: A Practitioner's View" (Harold W. Lundy and Glenda F. Carter); "Plant Operations in Transition: A Case Study in the Management of Change" (Gene H. Dippel, David Gray, and Gerry Smith); "'Hello, I'm Not at My Desk Right Now...': A Whimsical Look at the Use and Misuse of Voice Messaging and Menu Systems" (John True); and "Going to Extremes: A Statewide System SIS Implementation During Funding and Structure Instability" (Thomas A. Gaylord and Floyd J. Burnett). (SM)

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Proceedings of the 1988 CAUSE National Conference

TRACK II: Managing Technologies Integration

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Track II
Managing Technologies Integration

Coordinator:
Diane Kent
University of British Columbia

Management of higher education institutions can be influenced by the integration of technologies; in turn, good management practice must be applied to the task of managing that integration.

Subjects of papers in this track include how the integration of tools such as CASE and Information Engineering affects the way we manage systems development; what new technologies we can incorporate to help manage the scarce resources of facilities, finances, employees, students, instructional and research services, and information; how new technologies can be integrated with older technologies; and how the significant changes wrought by such integration can be managed throughout the institution.

Margaret V. Krol
University of Illinois

Bernard W. Gleason, Boston College

Computing in the 90's
Will we be ready for the applications needed?

Stephen Patrick

Abstract

The decade of the 80's has seen many profound changes in the nature of computing that are slowly being felt in administrative computing.

In the past, the mission of administrative computing was to provide record keeping support to service organizations. In the next few years the traditional applications we use to justify our (high?) budgets will not be seen as a valid reason for spending a significant portion of a university's budget.

For administrative computing management to survive in a position of influence on campus, we must determine what are the important administrative applications for the next decade, and provide them when needed.

INTRODUCTION

The University of Wisconsin - Stevens Point is completing the installation of a campus wide-network. My thoughts now look to the next step in the growth of computing and technology on our campus. Unfortunately, most of the technological leaders are in a similar position.

This paper provides a mechanism for evaluating the potential applications of the next decade. To do this, I develop a model based on Abraham Maslow's theory of motivation. Like all models, this one is subject to oversimplification.

TECHNOLOGICAL ADVANCES DURING THE 80's

In the "good old days" of administrative computing (1970's), computing was centralized and under control. Computing was controlled by a technocracy that perpetuated a mystical aura about computers, programs, and applications. Computing management considered this proper from their perspective. Computing management continually approached upper management to fund an expanded computing mission.

With the entry of the IBM PC in the early 80's, the computing environment changed. Personal computers began to appear across campus and were out of the control of the central computer organization. Computing was no longer restricted to the computer professionals.

Initially, personal computers were single-user computers. You could not perform many useful applications without moving data from one computer to another. Computer networking appeared to provide the solution to this problem. The growth of computer networking was bottom up rather than top down. People began by connecting small office networks. Later they tried to expand them.

SOCIAL CHANGES RESULTING FROM TECHNOLOGICAL CHANGES

Non-technical computer users became self-reliant. Secretaries, Deans, Department Chairs, Accountants, and in rare cases, Executives became knowledgeable about computing. Computing has traditionally provided a mechanism of making the work of an organization more efficient. The micro computer has made the work of individuals more efficient and effective.

There is now a dichotomy between mainframe and micro computer users and professionals. Mainframers think they are doing the real computing and personal computers are toys. Users of micro computers wonder why it takes years to develop mainframe systems when they can do it DBase in days.

In academic settings, the users of computers have changed. In the early days of computing, the main advocates of computing were the sciences. Computers were needed to perform calculations, simulations, or statistical analyses. The micro computer changed this orientation. Now the liberal arts faculty are among the strongest advocates of computers (at UWSP).

HIERARCHY OF NEEDS APPLIED TO ADMINISTRATIVE COMPUTING

The needs of each institution determine the computing applications needed by that institution. I will draw an analogy between computer applications and Maslow's theory of the hierarchy of needs to motivate individuals. Because Maslow's theory is an analogy to describe human behavior, I am making an analogy of another analogy.

Maslow's Hierarchy of Needs

Abraham Maslow, in his book "Motivation and Personality" developed a theory about the motivating factors for people. His theory states there is a hierarchy of needs that motivates people. The lowest unmet need motivates individuals. Once an individual has satisfied the lowest need, that need will not motivate the individual. I briefly describe Maslow's hierarchy of needs from lowest to highest below.

Physiological Needs

> The human body needs food, water and air to survive.

Safety Needs

> Once an individual has satisfied his or her physiological needs, security from uncertainty (freedom from fear) motivates the individual.

Belongingness Needs

> These needs relate to an individual being part of the group and having a spouse/and or children.

Esteem Needs

> These needs relate both to an individual's self esteem (feeling of worth) and the desire for prestige or respect from other people.

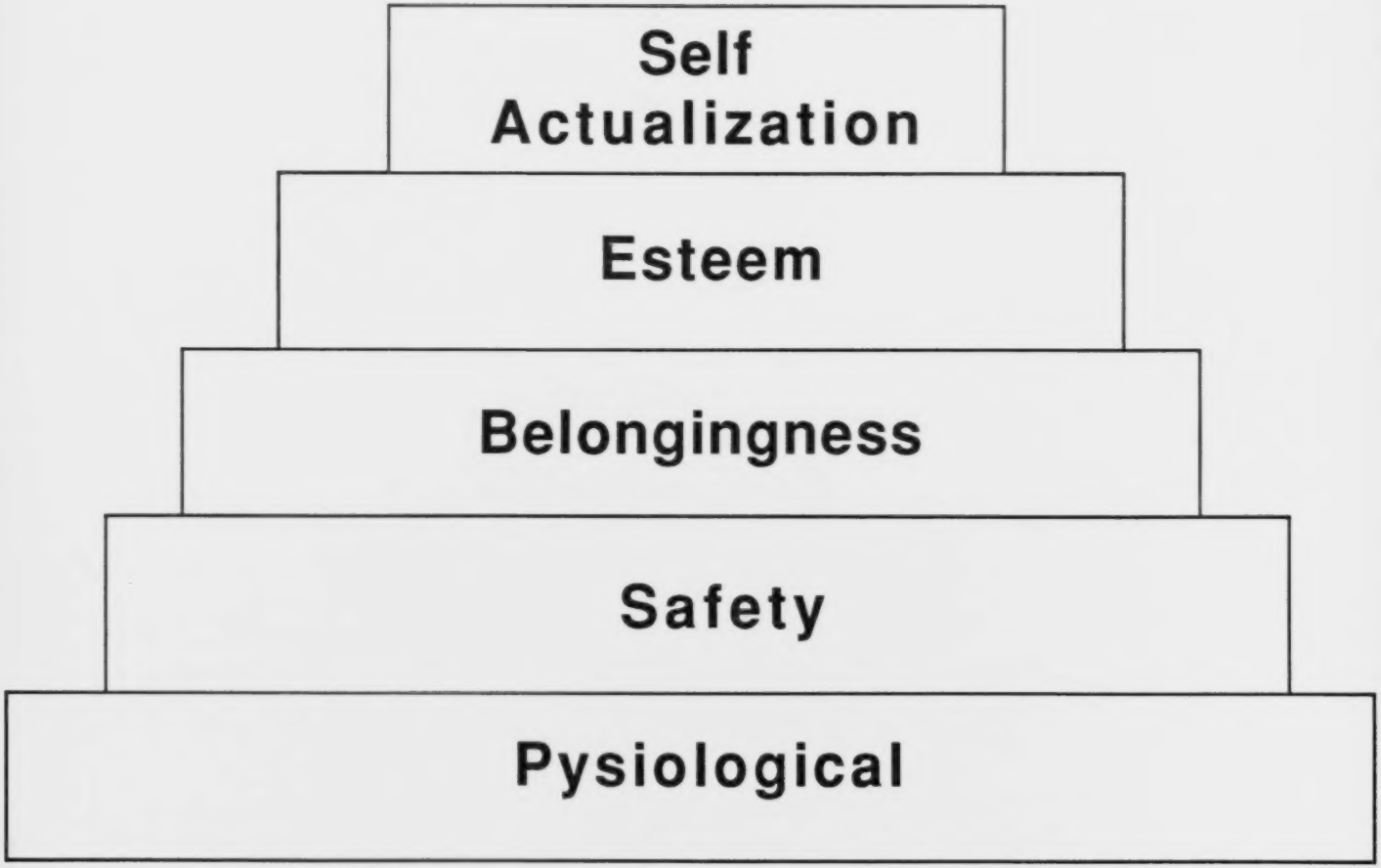
Self-Actualization

> At the top of the hierarchy is the need to attain the highest level of an individual's chosen endeavor of field. To be the best "Programmer" (Mother, runner, accountant, hunter, etc) possible.

These needs are a hierarchy with the higher level needs resting on a foundation of the lower order needs. If an individual's safety needs are unmet, belongingness factors would not motivate the individual. Once the safety needs are satisfied, belongingness factors would motivate the individual. One implication of this theory is that you cannot expect to use a single motivating factor to motivate a group of individuals. Each individual is at a different point in the hierarchy and therefore different factors motivate different individuals.

An illustration of Maslow's theory is to imagine how priorities change in a health crisis situation. One week you are concerned with your next promotion, or how to improve your golf score. If you then were to have a heart attack, your priorities would change quickly. You are now more concerned with survival (physiological needs) than anything else. Once you are over the immediate danger, you may change your lifestyle to avoid a future attack (safety needs). Only after you satisfy these lower order needs, can you return to fulfilling higher order needs.

Maslow's Hierarchy of Needs



In our society, we consider physiological and safety needs lower order needs while the other needs are higher order needs. Higher order needs are positive motivators (carrots). Lower order needs are negative motivators (sticks). To motivate at a level below an individual, you have to threaten that individual. As an illustration, you could not motivate an individual working on esteem needs by offering to satisfy safety needs. You could motivate that individual by threatening to lower the individual to the safety level on the hierarchy. This approach can backfire because the individual's solution to his or her problem may not be congruent with your goals (i.e. to find employment elsewhere). If you motivate an individual at or above that individual's need level you are helping the individual achieve his or her goals. This is the classic win-win situation.

APPLICATION OF MASLOW'S HIERARCHY TO COMPUTING

An example of how this analogy works in computing is to examine a Payroll system. Payroll was one of the earliest computer applications. By definition, this is a low order need. Computer center directors will get few rewards for having a state-of-the-art payroll system. What happens if you are late printing paychecks? The organization will find itself suddenly dealing with its physiological needs.

Listed below are a few of the administrative computing applications and my guess as to where they could be in Maslow's hierarchy.

"Physiological" Applications

- Payroll
- Accounting

"Safety" Applications

- Financial Aids
- Backup and Recovery

"Belongingness" Applications

- Networking
- Electronic Mail

Esteem

- ???

Self-Actualization

- ???

What are higher level applications?

To discover the higher level applications, we should look at the higher level needs of universities.

Esteem

Sports.

It is unlikely that an administrative computer application could significantly improve a university's athletic competitiveness. Keep an open mind for dealing with athletic opportunities. Those that directly support the improvement of a school's athletic achievements will yield rewards.

Nobel prizes.

Obtaining higher quality faculty for an institution appears out of the realm of administrative computing.

Super Computers.

Academic computing got here first.

Image.

Many colleges are in a continual effort to upgrade their image. Community colleges are trying to become four-year colleges. Four-year colleges are trying to become research universities.

Self-Actualization

To become the "best" university possible. This would emphasize one or more specialties of each university's specialties.

PROVIDING THE NEXT GENERATION'S APPLICATIONS

The computer applications that will be important depend on the state of computing and the university in the hierarchy of needs. You must allocate your resources to deal with the appropriate computing problems. Most organizations can only support a limited number of major initiatives. If you place your top priority to filling a need that is either above or below your institution's need level, you will be wasting resources on the wrong problem.

As an example, consider the case of an institution which has fulfilled its safety needs. An appropriate priority project could be either a campus-wide network, or integrating the campus with national networks. If the priority project were to install a new Accounting system, you would find little support (outside of the Accounting office) for this project. This is not to say that it is not important to have an accounting system. Don't try to use the accounting system as an excuse for not fulfilling other needs.

On any of our campuses, we could find a variety of individuals working on different levels. The stereotypical absent-minded professor is clearly at the self-actualization level of Maslow's hierarchy. This is not true of computing in higher education. Computing is a new field that has matured during the lifetime of most of us. Because computing began at essentially the same time for many institutions, we expect similar development patterns. Many institutions are dealing with the same needs at the same time.

If we look at what "leading edge" universities have accomplished recently, we see that the "hot" topic is networking. The Maslow model shows networking as a belongingness need. Leading edge institutions should soon be ready to attack esteem needs, followed by self-actualization.

ESTEEM NEEDS OF A UNIVERSITY

When computers were rare, they were often put on display to meet an esteem need. The computer was just there to increase an institution's stature. We can see this same phenomena with supercomputers and access to computers by students faculty and staff. Some institutions promote themselves based on the number or kind of computers present. Some institutions are requiring all students to purchase computers without evaluating their usefulness (we must be good, because our students need a computer).

Computerization of the faculty, and increasing the access to computers by students and staff is a legitimate esteem goal. We had great success when providing access to computers to a wide variety of non-technical faculty.

SELF-ACTUALIZATION NEEDS OF A UNIVERSITY

These needs involve making a good academic program, as good as it can be. I would consider making a mediocre program better to be an esteem need. Each university has one or two specialty academic programs. Direct support given to these programs will help the institution reach its self-actualization goals.

STRATEGIES FOR SUCCESS

Before developing strategies, you must determine the institution's position in the hierarchy of needs, and computing's position in the hierarchy. If the institution's position in the hierarchy is below computing's (hopefully a rare occurrence), find a new job because you will not get resources to accomplish any of your goals. If the institution is above computing's level (the most common situation), you must bring computing up to institution's level.

In developing strategies, be aware of the differences between positive and negative motivation. Your role will be to motivate top management to allocate resources to accomplish computing goals. You may be able to use negative motivation occasionally. Negative motivation, if overused, will motivate management to find a replacement for you.

CATCH UP

As previously stated, leading edge institutions have solved networking. If your computing is at a lower level, you are in a catch up situation. You have the option of doing nothing, which may be successful but is not interesting. Catching up is not difficult because other institutions have overcome the "leading edge" problems. Purposely trailing the "state of the art" far enough to avoid mistakes is a common strategy (followed by IBM). Networking is mature enough that the most conservative institution can succeed.

Your problem is more difficult if your basic administrative applications are not in order. In this case, you may not get good long-term support for solving these prolems. The best solution for this would be a quick fix (purchase a turnkey application). This places the implementation of the application in the hands of the user, and an outside vendor. With this strategy, you may still have resources to attack higher level problems. You would then emphasize the higher level problem, and downplay the lower level problem. This situation may require negative motivation to get the resources to do the job. If you do, try to get all the

resources you need committed once. You will have a very difficult time if you must repeatedly return for additional resources.

LEADING EDGE INSTITUTIONS

It is very difficult for leading edge institutions to predict where technology is taking us. We should be striving to help the institution achieve its esteem, and self-actualization needs. Look for opportunities to support athletics, and provide direct support for programs that are good and aspiring to be great.

Many of these applications appear to be in the domain of Academic Computing. Examples of administrative applications supporting higher level needs include recruiting, library applications, authoring and document preparation. A rule of thumb is to provide applications that directly support individual faculty members.

WHAT'S IN THE CRYSTAL BALL?

Up to this point, we have looked at campus needs, not technology. I do not pretend to be a technology forecaster, but a look at technical trends and current problems may give us an insight into the technological advances that should appear.

The IBM PC operating system (MS-DOS) has not been able to keep up with the advances in computer hardware. The architectural limitations of MS-DOS, 640 thousand bytes of memory, 32 million bytes of disk storage, and the 16 bit data path are major hindrances when memory is in increments of 1 million bits, and a 3 inch laser disk can contain 500 million bytes of storage. Parallel processor desktop computers can be mass produced at a cost comparable to current PCs. Unfortunately, we do not have an operating system or application software to take advantage of the computing power now available. Someone will solve this problem which could revolutionize personal computing.

Inexpensive mass storage will have an impact on many aspects of computing. Optical disks the size of a floppy disk can store 500 million characters of information. These units are used in library applications (periodical indexes), and in some database retrieval. We should look for optical disk technology to continue to advance with ever lower prices. This may provide new opportunities for information distribution. A significant portion of the cost for information dissemination is the cost of media (paper and ink), and transportation. With these costs reduced considerably, information dissemination will accelerate.

Artificial intelligence(AI) has been a popular buzz word for several years now without any tangible results. The problems with AI are that it takes horrendous computer resources to run AI applications, few people know how to program AI applications, and few of us can identify good candidates for AI applications (other than Financial Aid eligibility). We should expect to see an easy to use AI system that runs on a low cost "super" personal computer. If this system is good enough, it could sweep past the MSDOS generation and establish a new standard for personal computing.

Communication standards should finally arrive. This will mean that all computers will be able to coexist and perhaps even communicate with each other on the same network.

CONCLUSION

The era of the COBOL mainframe computing center is coming to a close. Traditionally, administrative computing was a service organization serving other service organizations. In the next decade, administrative computing must continue to be a service organization, but must transition to provide direct support of the institution's mission at all levels of the hierarchy of needs.

Glasnost, The Era of "Openness"

Bernard W. Gleason
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November 29, 1988

The demand on college campuses for access to administrative information by a broad range of the community — faculty, staff and students — is quickly becoming a network service requirement similar to electronic mail. The need for "openness" has been slow in developing primarily due to the natural divisions between academic and administrative computing and the serious security considerations.

This paper will discuss an overall systems architecture that will provide a platform for universal access to administrative systems information by all members of the university community. Special emphasis will be placed upon the unique security techniques, and a common presentation across all systems, voice as well as data.

Glasnost, The Era of "Openness"

by Bernard W. Gleason

We are in an era when progress will be shaped by universal human interest.

M.S. Gorbachev

Glasnost is a word in Soviet society that is commonly used to mean "openness." *Glasnost* is based upon the principle that citizens can enjoy their rights and freedom as long as the exercise of these privileges does not prejudice or jeopardize the interests of the society.

On our campuses, we are experiencing trends, such as the proliferation of networks, the rapid permeation of workstations, the integration of voice and data communications, and the emergence of the library as an information utility, that are accelerating the convergence of the academic and administrative sectors. At many universities, this thawing of cold war relationships has lead to a restructuring of the campus computing and communications society. In many cases, this on-campus *perestroika* has been carried out through democratic decentralization of computing. In other instances, reforms have been accomplished through open and cooperative computing, including access to administrative information.

At Boston College, we have followed the latter model, and have adopted a policy of broad and open access to all administrative information systems, including the transactional systems. It is our intent to provide all members of the University community with open access to information. This will improve information sharing among faculty, staff, students and others as well as provide higher levels of office efficiency and reporting across the campus.

Of course, this statement of intent raises a number of policy and security issues, and the resolution of these issues is apt to dictate the rate of implementation. In the application of the Soviet policy of *Glasnost* , it is likely that the government will reserve the right to control and regulate the move toward openness, and reform will come through evolution not revolution. The move toward providing broader access to administrative information is a process that has been going on for many years and, in fact, it is a strategic direction that has been under consideration and refinement at Boston College for over a decade.

In 1987, about the time that Mikhail S. Gorbachev espoused his doctrine of openness, the ideas that had been guiding the development of open administrative systems at Boston College were being formally organized into a set of concepts and guiding principles. The underlying premise of these concepts recognizes data as primary, technology as secondary and the building of a knowledge base as paramount. We will continue to see changes in hardware and software tools but the data requirements for completeness and consistency across all systems will remain constant.

For years, many of these futuristic notions of openness were routinely ignored by users as pipe-dreams and unnecessary overhead. We are now witnessing the emergence of new technologies and changes in the campus society that will greatly facilitate the turning of these concepts into practical applications. The realization that many of these dreams are about to come true has prompted the publication of this document.

Conceptualist's View of the World

Administrative managers and systems designers are often viewed as the campus politburo, a group of staunch old bureaucrats who are tied to obsolete technologies and are more interested in retaining control than sharing information. In reality, the fondest dream of every information systems manager is to apply positive change to the way that the institution will function, and every information systems manager is constantly conceptualizing and redefining the campus information model.

The conceptualist's or dreamer's view of systems should be distinguished from that of the strategist. The strategist may develop a plan covering many years including a statement of goals, objectives and the means to achieve the objectives. The statement of concepts is a formal document that contains a general set of principles but is not time dependent; the rate of implementation is governed by the availability of the technological tools and general compliance with strategic plans. This set of concepts is also subject to revision when the next good idea comes along.

At Boston College, systems planners have based judgements on a belief in long-term solutions. The user community has come to expect quick solutions and is being provided with more and better tools to implement these solutions. In this environment, it would appear that the conceptualist would have a difficult time functioning and monitoring compliance with principles. In addition, the visionary seed planted by the conceptualist may take many years to yield a practical application product, and the systems development group, as well as the user community, may not be enthusiastic about doing all the required groundwork if the effort may not have apparent near-term impact.

By the time a concept becomes a product, the individual who had the original notion may have left the institution or the principle may have become so universally accepted that the identity of the source of the idea has been lost. We all get satisfaction from a sense of a job well done but the conceptualist may never get the recognition. For example, in the early 1970s Boston College recognized the need for an automated library system and the future role of the university library as an information utility providing open access to the community and beyond. Even though we didn't have a specific plan or date when the automation of the library would take place, we began the retrospective conversion of the card catalog into machine-readable form. In 1981 in our Request For Proposal to vendors, we were able to state requirements for support of an on-line catalog in full MARC format. Vendors were astonished to discover that the conversion of nearly one million volumes had already been accomplished.

In 1982, the library system was implemented and in 1983, we moved into the new Thomas P. O'Neill Library without the card catalog. The on-line catalog became a showpiece for Boston College. It wasn't until knowledgeable visitors began to ask, "Are you telling me that the total collection is on-line?" before campus administrators began to realize the significance of the conceptual vision. It was only then that the individuals who conceived the idea could experience some sense of job satisfaction. But the process is never ending and we are now poised to apply a whole new set of concepts that will make it even easier to access library materials.

There are many other examples of the application of concepts, and the unfolding success of the *Glasnost* project is a tribute not only to the foresight of certain individuals but also to the dedication and the discipline of the systems developers which has guaranteed adherence to the concepts.

Information as a Free Resource

The development of the library system did not end with the retrospective conversion of the card catalog and the implementation of the on-line system. A whole new set of

concepts began to be developed, and currently Boston College is engaged in projects that will provide access to large number of information databases and external information services over the campus network. It is conceivable in the not too distant future that expert systems will provide users with an intelligent interface that will provide help services similar to those supplied by a reference librarian. It is also easy to envision the day when a user will have access to full text retrieval capabilities. For example, if I was researching this topic, I may have performed a simple search through all available text looking for all instances of "Gorbachev's policies of *Glasnost* " and retrieved all the appropriate passages.

The future of the library as an information utility extends beyond the existing boundaries and the notion of the library as a free resource to find information applies equally to administrative systems information. The same methods are used to access both administrative and library information and there are no charges for service.

Establishing Authority Control

In any discussion of access to information there is usually a debate regarding the granting of authority to retrieve data. In most instances, operational information flows across the University from department to department in a horizontal manner and is not restricted by organizational boundaries. On the other hand, authority to access management information tends to be vertical and the routing of the information and the permission to access the information passes up through the hierarchical organization structure. The information systems manager is often placed in the position of seemingly not providing the desired information and not having the authority to take corrective action.

Offices who have custodial responsibility for data are not usually reluctant to release information to proper recipients but there is a genuine concern for misuse. This concern often leads to the custodial department releasing a limited amount of information on a periodic basis and establishing a procedure to review all requests for additional information.

Compounding this dilemma is the inaccurate reference to the top computing position as the Chief Information Officer (CIO). The information systems manager is responsible for the management of the computing and communications facilities and the design of the systems but has no authority to create, modify or distribute information. Perhaps, a more appropriate name should be Chief Computing and Communications Person and, for emphasis, he or she should wear a jersey with **CCCP** emblazoned across the chest to help identify the true role.

The real information czar on campus is the Chief Executive Officer. At Boston College it is our intent to provide executive management with accessibility to every possible piece of information, except data that may violate the confidentiality of individual's records. The means for providing this information is through an Executive Information System (EIS) that uses all of the features described later in this report. In this environment, any political issues relating to access to information are handled outside of the information systems organization, with executive management providing the authorizations. Using this approach means that the information systems manager needs to provide the information and maximum flexibility and worry about the application of distribution authority at a later time.

Data Management and Integrity

While the term "centralized" may be viewed in campus political circles as a dirty word, centralized planning is a key factor in the design of a campus-wide system that will support the concepts of *Glasnost* . Centralized management of the primary knowledge database is necessary to provide the high degree of referential integrity needed to ensure the

validity of shared data. This strong statement of data management applies whether or not the environment is distributed, and the distinction between planning, management and control is very important. Control belongs to the users, planning is a joint effort, and management of the environment is a responsibility of the information systems staff.

At Boston College, we have developed an integrated systems architecture that provides a platform on which to build all applications and enables campus-wide data sharing. These systems can be characterized as interactive, integrated and highly standardized. The application of standards includes screen formats, program structures, naming conventions, data definitions and access codes, resulting in a consistent"look and feel" across all systems.

The conformity to standards and a single architecture has provided some obvious technical benefits but it has also furnished a base for providing a true end-user computing environment characterized by ease of access and intuitive interfaces. In the true end-user environment, all transactional data and information is entered directly into the system by the originator, not some intermediary. For example, professors can enter grades directly into the system, students can register for courses, advisors can retrieve degree audit information, chairpersons can prepare course descriptions, and the list goes on, and the extent of the capabilities is only limited by the designer's imagination. Many of the examples cited above may require automated approval procedures but they are all illustrations of the reduction of clerical tasks in the Registrar's Office and the elimination of the manual transmission of paper among parties.

Intuitive Representation

Many computing and communications interfaces gain the label of "intuitive" not only because of the so called "ease of use" but also because of the acceptance that commonly used interfaces have gained through broad exposure. For example, the telephone has been an accepted medium for a long time. Western society has now embraced a variety of interactive devices, such as voice response units and ATMs (Automated Teller Machines), that weren't even a consideration for broad public use a decade ago. In the last couple of years, the quick acceptance of graphical interfaces by the user community has been recognized and promoted in the computing industry as the future of man-machine interaction. In the next few years, we expect to see interfaces with expert systems capabilities that will allow even the most unskilled individuals to easily interact with systems. At Boston College, we have adapted the systems architecture to accept these "real world" solutions and to be positioned to embrace the impending flow of application tools that will support voice technology and graphical interfaces.

In administrative systems, graphics have long been a desired means of displaying report information, and as mentioned, the graphical front-end is emerging as the common user interface. The missing piece is the storage and management of the knowledge base in graphical form. For instance, when we think of a building, we visualize a floor plan, not room numbers, square footage, coordinates, etc. in data form. The common user image of organizational charts is a hierarchical structure in graphic form, not departmental account numbers and names linked together in a database. Individual students are recognized by facial image, not a social security number. The campus network is commonly represented as a topographical view of cables and conduits layered on the campus and building blueprints. In the past, systems designers have chosen to shortcut or avoid the automation of these graphical databases for a variety of reasons most notably, the memory and storage requirements and the limitations and/or costs of workstations.

In its simplest form the University is composed of a set of buildings and a collection of positions that are occupied by individuals who teach, conduct research, answer telephones, operate computers, etc., and these fixed components of buildings,

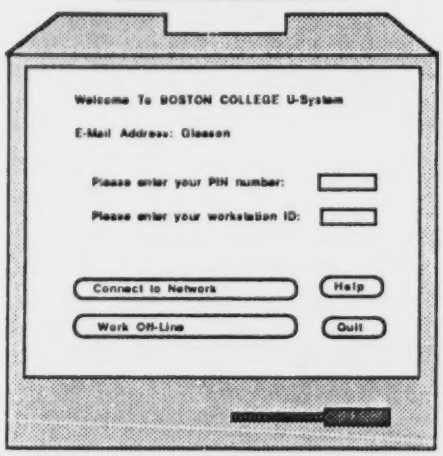
departments and positions are the principal database design components. Designers of university information systems have traditionally advocated the implementation of Student Record and Financial Accounting Systems as the primary building blocks and including limited data tables for the fixed resources within those systems. These two application systems are certainly the most important from an operational standpoint but are secondary in the design of the total integrated system.

Hype vs. Reality

Brian Hawkins, the Vice President for Information Systems at Brown University likes to apply what he calls the "hype/reality index" to presentations. At Boston College, most of the features described in this paper are already operational or there is an active plan for implementation over the next year. Most importantly, the single systems architecture, the single security system and the data requirements are all complete. The hard work is all done, and as new vendor offerings become available, we will simply attach the appropriate services to the system.

We are front-ending the current data systems with a variety of easy-to-use interfaces. It is our strategy to concurrently support microcomputer access with graphical interfaces that provide terminal emulation and a client/server relationships. It is our expectation that the structure and location of the target database will be less of an issue and that there will be a continuing migration toward a client/server environment. The user interface and the data requirements will remain constant but the residency of the data and the communications capabilities will change. One of the first steps will be to distribute application access and security down to the server level. The security routines will need to be more than the common log on, password procedures.

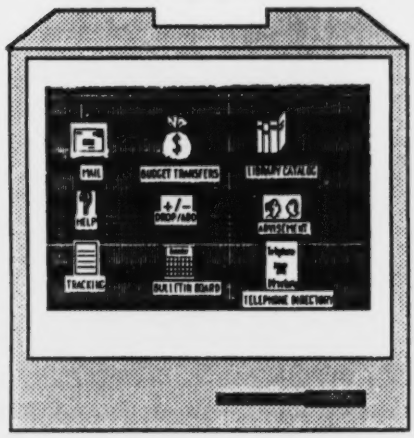
COMMON LOG ON



The information system has been designed so that the user views a single system that is customized to the individual users needs with the appropriate functionality, instead of a series of seemingly independent application systems with separate log on procedures for each system. Users are presented with a common user interface across all systems and computing environments, and users interact with a consistent sequence of log on entries. This common log on sequence applies to access by telephone as well as workstations.

After logging on to the system, the user is presented with a menu of functions. The operator establishes a dialog with the system that states the desired functions immediately without needing to select an application system, signing on to that system and stepping down through a menu structure. In addition, users view the system as a single system and they can move from one function to another without logging off and logging on application systems. This function-based menu approach also provides the user with transparent access to data, thus eliminating the need to know where data is located. These function-based menus are customized by associating an individual with an access classification (faculty, staff or student) and providing an appropriate portfolio of functions.

FUNCTION BASED MENUS



The portfolio may contain a variety of software resident on workstation, server and host environments. The establishment of software standards at all levels facilitates the ease of cooperative processing in a transparent mode. For example, the user may create a mail message by composing the memo on the workstation and only attaching to the network when the user wishes to send the memo.

The pointing and clicking on a function will create another window with a set of menu functions.

The function based menus are designed primarily for the uninitiated users; they do not preclude access to application systems using traditional terminal applications. In fact, many high volume users will continue to operate in a locally attached mode with a fixed function workstation in order to attain maximum productivity.

Security

When the provision of open access was first discussed at Boston College, the immediate concern was security, the absolute protection of data and the confidentiality of information. Secondary concerns were the provision of adequate computing and communications capacity, the incompatibility of various terminal devices and keyboard devices. Lastly, the major administrative question was how to maintain the individual security profiles of thousands of individuals without expanding the security administration function to the equivalent of an on-campus KGB? The resolution required some ingenuity and resulted in a novel approach of assigning security to job positions, instead of individuals, and adapting the production data system to control the security system.

At log on execution, users are allowed to gain privileges in one of five ways:

1. by groups or classes to which they belong, i.e. faculty, staff and students;
2. by responsibilities associated with specific jobs;
3. by individual (access to their own records);
4. by data dependency; or
5. by organizational structure.

At the time that an individual logs on to the system, the system applies the rules and develops a set of user profiles. The security facility will then map all of the appropriate profiles together so that a composite of the individual's privileges is recalculated at the start of each session. At the time that an individual becomes associated with the University or changes status within the University, their personal information is entered into the system (Human Resources or Student Record Systems) which automatically alters the individual security profiles that are associated with the individual. The person's personnel and/or registration records determine the individual's group or class assignments.

The Human Resources System contains a position control function. As individuals are hired, terminated or change positions, the system automatically assigns position-specific attributes, such as office location, telephone number, job title, etc., to the individual. In addition, the system assigns the security profile associated with the job. Individuals may hold multiple jobs or may attend classes as well as be employed.

Individuals have access to their personal records. This is strictly a one-for-one relationship. For example, a student can access his/her student account, financial aid, grades and other records, employees can access their own personnel, payroll, and student records.

Individuals also have access to records based upon the data that is resident in records in the production systems. For example, a faculty member has access to records of individual students for advisement based upon the registrar's designation of the faculty member as the advisor in the student's record.

The hierarchy of departments and positions is defined within the system and individuals, by virtue of occupancy in a position, may have access to information that is available to individuals in positions lower in the structure. For example, access to budget information for a grant in the Biology Department is provided to the principal investigator by virtue of his/her job responsibility. The Dean of the college, who may be seven or eight levels up in the hierarchy may not be directly responsible for the budget but would have authority to access the budget information using a workstation or telephone voice response.

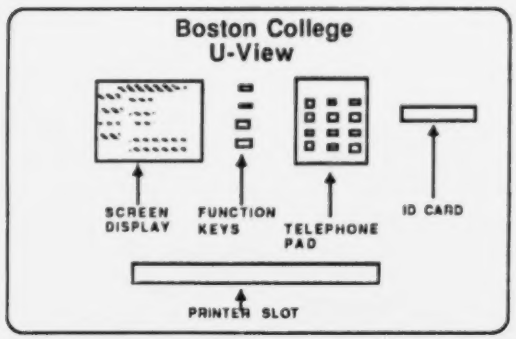
Access Methods

The provision of wide-spread access builds upon the existing architecture and protects the current investment in information systems. The design also recognizes the realistic provision of access devices and the current configuration of communications capabilities. At Boston College, like most campuses, there are a variety of existing terminals and microcomputers in offices with varying communications capabilities. The one constant is the telephone.

The system design permits the access to information from multiple device types. In cases where the telephone is used to interact with the system, the application is designed to function the same on all platforms, with the telephone keypad being the lowest common denominator. We refer to this design as RISK, or Reduced Instruction Set Keyboard, technology. An example of this type of application is student course registration drop/add. In this application, the user is restricted to numeric entries (i.e. social security, PIN number, course numbers, and selection and response keys) and function codes (i.e. star and pound signs). The terminal operator in the Registrar's Office with a full-function keyboard would use the same limited keyboard functions and numeric entries, and the same would be true for a student processing the transaction using an ATM-type device.

In the open society, there are no borders and curfews, and the lifestyles of students are not synchronized with the standard, Monday through Friday, 9:00 to 5:00 office hours. The servicing of students in the library and public computing facilities and normal access to computing networks is now a seven day/24-hour proposition. Students will utilize the services of the network, not only for course work, but also to access administrative systems, similar to the way we now conduct our banking business.

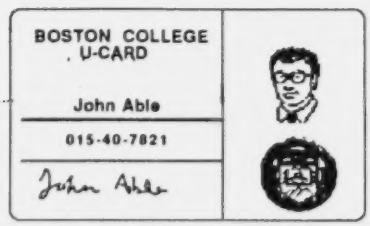
ATM ACCESS



Students have the ability to conduct business with the administrative offices of the university any time of the day through the use of devices similar to ATM machines used by banks. The interface (log-on sequence) is consistent with all other devices and utilizes the single security system. In this case, the university ID card functions as an additional security identifier.

Unlike the common banking ATM device, this machine/terminal does not have a cash function. It does have an eight inch printer, and students can retrieve a variety of information from the Student Record System. For example, students can check to see if their student loan has been processed; they can drop and add courses, they can retrieve a revised class schedule in printed form; they can read electronic mail messages.

UNIVERSAL ID CARD

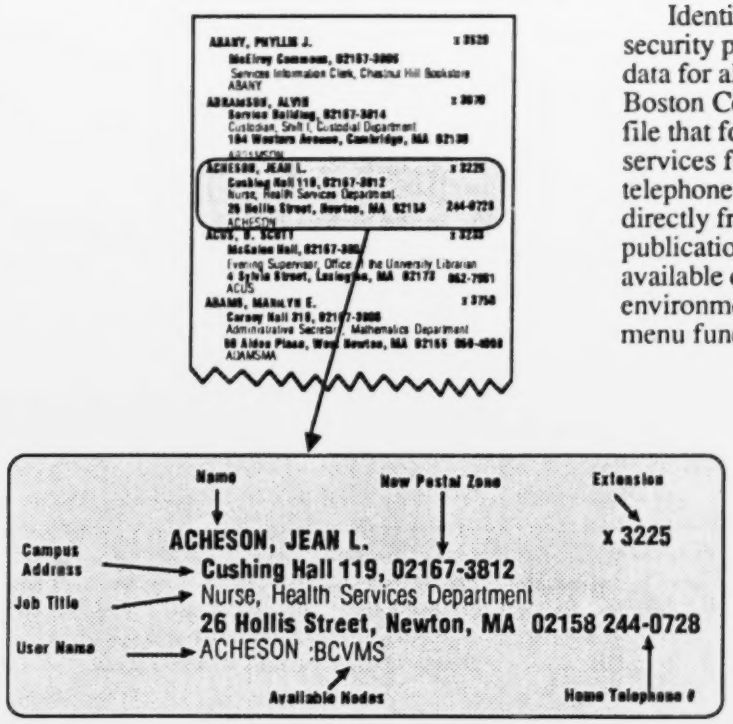


As soon as an individual is identified through the transactional system as being associated with Boston College as an employee or student, the system automatically generates identification information. Usually the first action of a new student or employee is to obtain a University ID card. This card serves as a passport that has universal usage across campus.

The system automatically generates a unique username, password and PIN (personal identification number) for each individual. The system automatically generates a letter that includes the user's identifiers, voice and data privileges, and operating instructions so that the individual can begin accessing the system on the first day of eligibility.

The system can recognize individuals not only by username, PIN, and password but also other identifiers, such as name, social security number, ID card bar code and ID card magnetic stripe. In addition, the system is designed to allow retrieval of an individual identity through departmental directories or by pointing to graphic representation of a building floor plan or an organization chart and determining the occupancy of the cell.

CAMPUS DIRECTORY



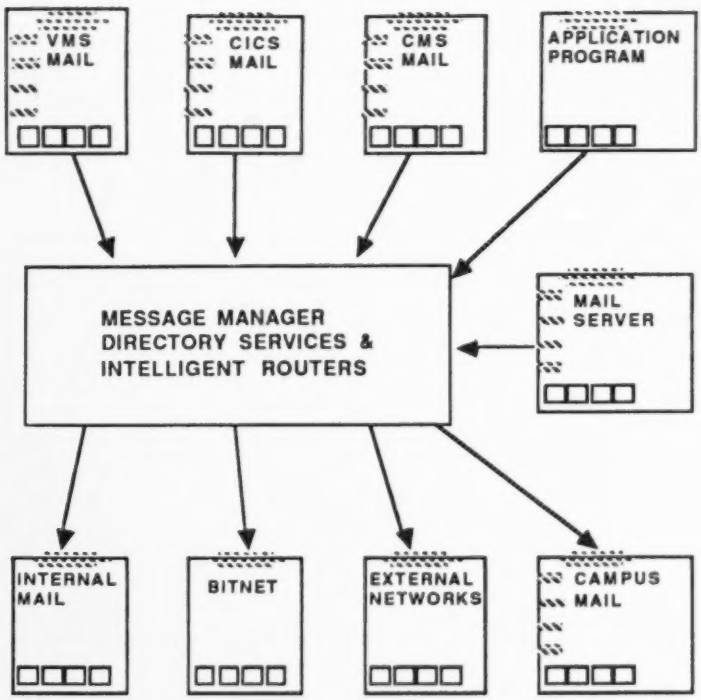
Identification information, security profiles and demographic data for all individuals associated with Boston College is stored in a single file that forms the basis for directory services functions. The campus telephone directory is extracted directly from the system just prior to publication. This directory is also available on-line in all computing environments as one of the standard menu functions.

Built into the transactional systems are intelligent routers composed of a set of tables maintained by custodial user departments. These routers allow a user to execute mail or forms routing transactions without stipulating the receiving party or parties. The designation of recipients is determined at execution time by associating tables of positions with individuals and making an assignment. An example of the use of this capability is in U-Buy, the campus-wide on-line accounts payable/purchasing system, when a user issues a purchase order, U-Buy knows who to route the form to for an electronic signature.

The system uses a similar type of mechanism to provide the user with transaction generated messaging. The theory is to have intelligent agents that know "who should know what" and automatically trigger messages based on an activity. This feature alerts individuals on a timely basis rather than requiring the user to execute queries. A possible example of this facility would be automatic generation of a message to a professor alerting him/her to a student's withdrawal from a course taught by the professor. Another example would be the generation of a message that would alert management through the Executive Information System (EIS) of exception conditions.

Individuals can also initiate mail by addressing the message to a group and utilizing automatic distribution capabilities. For example, a professor could address a class assignment to all students enrolled in a course as long as the system determined that the professor issuing the memo is also the instructor. If authority is granted, the system would use the class list to determine the students and the corresponding directory entries to determine the appropriate routing schemes.

MESSAGE ROUTING



The system will accept messages and forms from different computing sources and a single routing scheme will be utilized for distribution of all messages and forms. Users who do not have an electronic address or do not read messages within a prescribed time limit will receive a printed copy automatically through campus mail. All of the computer-generated campus mail is pre-sorted in accordance with the filing scheme in the campus post office.

The electronic and paper campus mail facilities are integrated with the voice mail system so that users are alerted to entries in their voice mail boxes from the electronic system and vice-versa. When a user provides a PIN number to the telephone system for long distance access, it is the same PIN number that is used when logging on to the data system, and telephone access security and privileges are managed by the same security routines and techniques.

Users can also access administrative systems information through the use of a touch-tone phone. For example, a department manager can check on the status of a budget by entering an authorized account number, and prospective students can check on the status of their applications. The system supports both stored and synthesized voice applications, and the selection of the appropriate technique is based upon the audience. The time spent on the phone checking the status of an item can be extremely frustrating. All systems at Boston College have been designed with date and time stamp functions so that users can perform status checks using either voice response or workstation access.

The integration of voice and data technology is put to best use in the servicing of the large community of users. Despite the ease-of-use of systems, the dispersion of access to a

vast audience results in a significant increase in support requirements. At a help desk the incoming phone number can automatically trigger a profile of the user and associated computing and communications hardware and software components. The problem resolution may result in the automatic forwarding of the call and/or screen image.

The key ingredient is a completely integrated system that manages not only the information in administrative data bases but also the computing and communications resources, including workstations, software, and network cable plant and connections.

Glasnost, A Time For "Publicity"

While *Glasnost* has been widely accepted to mean openness, the literal meaning of the word is "publicity." The time has come to publicize the benefits of open administrative systems. While thousands of hours of effort have gone into the design and implementation of production systems that have serviced functional departments, it is not uncommon for a minor, but sometimes visible, element of the system to gain attention and applause.

More importantly, the provision of open access to the masses has a high impact. In the past, access to information has been reserved for a relatively small number of administrators. Reform is now upon us and it is time to service the proletarians, the unpropertied class, our students and other members of the community.

Boston College
Doctrine of *Glasnost*
Concepts and Guiding Principles

Systems Architecture

Administrative systems must be completely integrated to allow interactive data sharing as though there was a single system.

All members of the Boston College community (i.e., faculty, staff, students, prospective students, alumni, outside agencies, etc.) must be provided open access to administrative information.

All screen displays, report formats, and program code must conform to consistent structures, resulting in the same "touch and feel."

A form must have an equivalent screen that corresponds one-for-one in sequence of data fields and entry. This capability must allow users to view a facsimile of the actual form on the screen during entry.

The design of a database structure must recognize that the relatively fixed components of the University database system provide the primary foundation, and implementation of these system components must proceed areas such as Student Records and Financial Accounting.

Appropriate databases must be maintained in both graphical format and data format.

System security must permit a single log on sequence and consistent user interface across all computing and communications environments.

Users must be provided access to function-based menus, resulting in transparent access to data and the ability to move from one function to another without logging on and off.

Design must support a smooth migration from a time-share to a cooperative processing environment.

Security

Access privilege assignments must be position-based rather than by individuals.

The production administrative computing systems must dynamically modify security access profiles.

A single University ID card must be issued to all faculty, staff and students for use in all functions across campus.

A single real-time directory of all members of the community must be available in all environments and be the source for the campus telephone book and the routing of electronic and campus mail.

The campus directory service must be able to cross-reference individuals by social security, personal identification number, passwords on all systems, ID card bar code, ID card magnetic stripe, and username.

The organization structure and the hierarchy of positions must be able to participate in the determination access levels.

Primary custodial offices must have direct responsibility for security assignments.

Information Flow
The same directory services and routing schemes must be used for the routing of mail, files, and forms.

Electronic and voice mail must be integrated.

The system must have built-in intelligence to be able to determine the recipient(s) and pathways rather than requiring the initiator to stipulate the destination.

Messages must be automatically generated based upon the activity in a transaction. The system must be able "to know who needs to know what and when" and be able to route the message through the mail system.

The system must make automatic adjustments to mailing lists, including mailing and electronic addresses, to correspond to real-time changes in data and/or job responsibilities. It must support the ability for a user to address a message to logical group.

All activities must be date and time stamped to provide ease of status checking across all systems.

All batch system must automatically feed a receiving system without any re-keying of information.

Access Methods
Information must be accessible from any workstation, special device, or telephone.

Appropriate data entry applications must be able to be reduced to a keyboard equivalent of a telephone pad.

A variety of special devices (i.e. voice response units, ATMs) must be employed to provide a high level of access and service.

Access to administrative information must be available beyond normal office hours.

Both synthesized and stored voice techniques must be available for interactive retrieval and modification of data.

The computing environment must be integrated with voice to allow access to information based upon a telephone call.

Academic and Administrative Computing
Are they really merging?

Samuel J. Plice

The University of Michigan

Ann Arbor

Michigan

ABSTRACT

In recent years, it has been stated that academic and administrative computing are merging and that there is no real distinction between them. At the University of Michigan, academic and administrative computing have been placed within a single organization, the Information Technology Division (ITD). From one perspective, it is true that academic and administrative computing have merged. From another perspective, however, it is apparent that while there is some sharing of resources, academic and administrative computing remain distinct entities. This paper provides background on the University of Michigan Information Technology Division, indicating where administrative and academic computing have come together, where separation still occurs, and what the prognosis is for further consolidation. By examining these issues, it may be possible to gain insights into the degree to which administrative and academic computing can effectively merge.

Academic and Administrative Computing
Are they really merging?

I. Introduction

At several of the conferences that I have attended over the past couple of years, the statement has been made that academic and administrative computing are merging and that there is no longer any real distinction between them. At the University of Michigan, academic computing and administrative computing have been placed within a single organization known as the Information Technology Division (ITD). From one perspective then, it is true that academic and administrative computing have merged at the University of Michigan. From another perspective, however, it is apparent that while there is some sharing of resources, academic and administrative computing remain to some extent distinct entities. What I want to do today is to first give you a little background on the University of Michigan Information Technology Division, indicate where administrative and academic computing have come together, where separation still occurs, and what the prognosis is for further consolidation. My hope is that by examining these issues, we can gain some insights into the degree to which administrative and academic computing can effectively work together. My opinions are drawn from the perspective of a large institution. The perspective of a smaller institution may be different, but I hope what I have to say has some relevance.

II. University of Michigan Organizational Structure

The Information Technology Division at the University of Michigan combines administrative and academic computing. Whereas the Director of the Computing Center formerly reported to the Vice President for Research and the Director of Administrative Systems formerly reported to the Vice President for Finance, now both report to the Vice-Provost for Information Technology. This change was in response to an announced objective of the University to take a leadership role in information technology. The Office of Administrative Systems includes the Data Systems Center (DSC), which is responsible for operations, Information Systems and Services (ISS), which is responsible for applications, and Telecommunications Systems (UMTel), which is responsible for management of our telephone systems and our wire and cable plant.

III. Technology Base

The Computing Center operates an IBM 3090-600E and runs a University developed operating system known as the Michigan Terminal System (MTS). This timesharing system was developed over the last 15 years and has provided outstanding service to the University community. In recent years, messaging and conferencing have become the leading applications running under MTS. The network, known as UMNet, is a packet switched network that is X.25 compatible and operates using University developed software.

The Data Systems Center operates an IBM 3090-300E running MVS. Over the last 15 years, virtually all applications have been developed in IMS and share large corporate data bases. We're just beginning the use of DB-2 but expect most of our applications to utilize DB-2 in the future. Other software includes TSO, Roscoe, SAS, RAMIS, ASI/Inquiry for data base queries. We also run a message system that communicates with the MTS message system over the internet. DSC shares an SNA network with the University Hospital which also operates an IBM 3090-300E. An IBM 9370 located at DSC serves as a gateway between SNA and UMNet.

Telecommunications Systems (UMTel) operates two Northern Telecom SL-100 circuit switches, one of which has been upgraded to SuperNode status. UMTel installs and manages all twisted pair wire, cable, microwave, and optical fiber. UMTel also provides support for LANSTAR packet switches running Banyan Vines, Appletalk, or Novell network software. Phonenet and twisted pair ethernet installation is also provided by UMTel.

IV. Budget History

Since the creation of ITD, the budget has grown to $54,700,000. Of this, UMTel comprises $20.9M, or 38%; the remainder of OAS is budgeted at $12.6M, or 23%; the Computing Center is budgeted at $11.6M, or 21%, and the remainder of ITD is budgeted at $9.6 M, or 18%. Central funding for OAS has grown from $1,713,000 in 1984 to $2,544,000 in 1989, an increase of 48%. The central allocation for academic computing, including the Computing Center, over the same period has grown from $2,761,256 to $13,344,621, an increase of 383%. As can be seen, administrative computing has not received the influx of central support for operations that academic computing has.

Because of a recent joint agreement with IBM, about which I'll talk in a minute, the DSC mainframe was upgraded from an Amdahl 5860 to an IBM 3090-300E at a cost to DSC of about $500,000. This relieved DSC of a significant capital expenditure in 1988. The money that would have been used to make a down payment on a mainframe was used instead to equip OAS with microcomputers. This represents a major one-time influx of resources to DSC resulting directly from the ITD joint agreement with IBM.

V. ITD Information Technology Strategy

The University envisages a network centered, workstation based, server enhanced multi-vendor strategy. Although the technology expected to be employed throughout is not fully known, some of the details are beginning to fall into place. Much of this comes about because of two major vendor relationships. In August, the University and IBM announced that they would work together on an Institutional File System (IFS), aimed at making the large IBM mainframes act as file servers on the institutional network. In September, the University and Northern Telecom announced the installation of a comprehensive fiber backbone network for the Ann Arbor campus.

Local area networks will be interconnected via fiber using FDDI and TCP/IP protocols and will download shared files from the mainframe file servers developed under IFS. OS/2, Apple, and Unix workstations will be supported. The three IBM mainframes and their disk storage will be accessible via the fiber, making physical location of the data or of the hardware transparent. Access to outside information resources can be achieved via the National Science Foundation Network (NSFNet), whose operations are being managed on the University campus under an NSF grant. Students living in private residences are expected to be able to connect to the campus backbone via ISDN through the local Michigan Bell Telephone Co. switch and by means of PRA connections to the University's Meridian SL-100 SuperNode.

Administrative data stored in administrative data bases on the DSC computer will not be directly accessible via the IFS. Instead, a pseudo-file will be created using a remote access process to extract data from the IMS data bases. A network based security and access control system will need to be developed to enhance the usefulness of the IFS, although that is not now included within the IFS project. We expect to mount efforts directed toward the use of a "smart" card or perhaps the use of the kerberos system developed at MIT. Since the University has 16,000 full time faculty and staff, 35,000 students on the Ann Arbor campus, and an additional 15,000 part time employees, a network of over 30,000 workstations must be supported. Electronic communications with other campuses, supercomputers, and networks will be achieved via NSFNet, which is now managed on the University of Michigan campus by MERIT, the Michigan higher education packet switched network.

VI. OAS Information Technology Strategy

The Office of Administrative Systems, having developed all of its systems using IBM technology, expects to continue doing so, and will implement a large piece of the Systems Application Architecture (SAA). It is anticipated that a great deal of the processing will be done using OS/2 workstations communicating via SNA. At the same time, OAS must recognize the IFS and be prepared to communicate with OS/2, Apple, and Unix-based workstations using TCP/IP protocols. A 9370 processor on the SNA network serves as a TCP/IP gateway. Many new applications will be developed using DB-2, IBM's relational data base product, and a great many systems will continue to run under IMS, IBM's hierarchical data base product. OAS also supports a large but diminishing Wang network, as well as a small but growing population of Banyan Local Area Networks. Protocol emulation provides 3270 access to the administrative mainframe via the Wang systems, Banyan servers, or UMNet, the academic asynchronous network. TempusLink is the product that enables downloading of data from the mainframe to microcomputers. Ad hoc data inquiries or batch listing can be made using ASI/Inquiry and the data can be moved to the microcomputer hard disk via TempusLink.

VII. Areas Where Sharing of Resources Has Occurred

For several years, OAS has had a planning function in place. Originally, this staff was engaged in planning for the development of large shared data bases. In recent years, their charge has expanded to include assisting administrative and academic departments in planning for increased use of computers. The scope of this group has been expanded again with the creation of ITD to include planning for academic use of computers and well as administrative use. This group, now called the Departmental Planning Team, includes persons from both the Computing Center and OAS.

Recently, ITD undertook to support LAN activity. The supported networks are Banyan Vines for IBM PC's and compatibles and AppleTalk for Apple machines. Twisted pair wire is the transport of choice for all local area networks, including PhoneNet, twisted pair ethernet, and LANSTAR. The Committee that did the initial investigation of LANs was a joint Computing Center-OAS committee, and the support staff in place now consists of both Computing Center and OAS personnel. UMTel is heavily involved in establishing these connections. UMTel also installs and maintains all inter-building and most intra-building twisted pair, cable, and fiber networks. The UMTel twisted pair wire is also used to connect workstations to UMNet, the campus packet network. About 6,500 data connections have been installed by UMTel.

Most microcomputer support is provided by the Computing Center. Staff are available to help users with hardware, operating systems, and applications software. Most microcomputer training is done by the Computing Center. OAS does some training in microcomputer usage, concentrating on applications specific to administrative users. For example, administrative users tend to use Office-Writer for word processing whereas academic users tend to us MS Word. The Computing Center supports only Word, therefore OAS must support Office-Writer.

The area where the most sharing occurs is in the network. UMTel provides the transport for most computer networks on campus. UMTel and Computing Center personnel worked together on designing the fiber backbone network which UMTel installed. Gateways between the Computing Centers packet switched network (UMNet) and OAS's SNA network use TCP/IP protocols to achieve file transfer and messaging. However, administrative users tend to use commercially supported communications software while academic users rely on communications software developed by the Computing Center. Users who use both mainframes heavily do not use gateways but have the ability to attach directly to either network. Administrative users tend to use IBM PC's whereas academic users tend to use Apple, Sun, or Apollo microcomputers.

VIII. Barriers to Greater Interaction

I was asked by the CAUSE program committee to talk about barriers to greater interaction between academic and administrative computing. I find myself unable to say much about that because I see little justification for additional interaction, at least in a large institution. If you break the subject down into its individual components, very little commonality can be found:

- Architecture. The academic computing center has the primary responsibility for putting in place the architectural platform on which faculty and students can build their applications. This architecture is evolving into one that facilitates the use of very powerful workstations used individually or in small work groups, generally doing large amounts of processing on small amounts of data. It is specifically designed to facilitate a multi-vendor approach.

  The administrative computing emphasis is on shared applications which operate on a very narrow architectural platform. This architecture facilitates high volume repetitive transactions used commonly by many users. It is most often designed specifically around IBM technology.

- Hardware. Most administrative computing centers do use IBM mainframes. Many academic computing centers do as well, but there are many that use Vax machines and some are running vector computers as well as linear processors. There may or may not be commonality in hardware. In large institutions, even where identical hardware is used, more than one machine is normally required.

- Software. Academic computing centers provide software tools for faculty and staff to use as they see fit. These users develop applications usually intended for small subsets of users and often having a relatively short life span. Administrative computing centers provide applications that are part of the control systems of the institution. They must run reliably and predictably. These applications are shared by many users and typically stay in place for many years. There is little commonality in software.

- Security. The integrity of the corporate data bases, and the privacy of individuals about whom we keep records, are fundamental concerns of administrative data processing. We use security mechanisms to inhibit free access. Academic computing centers want to make their software tools as available as possible. Security mechanisms are intended only to protect individual files from unintended sharing. Current administrative security mechanisms are too intrusive to be tolerated on the academic side.

- Staff. If both academic and administrative computing is done on the same hardware base, then there may be some savings available from combined operations. However, if all mainframe hardware is located in a single building, there is a much higher risk of fire or other major event destroying all of the campus computing power. Administrative computing centers have large staff devoted to developing applications using commercially available software. Academic computing centers have staff devoted to maintaining and enhancing specialized software tools. While there is some overlap, there is minimal commonality in staff expertise required.

- Management. Academic computing centers tend to be tied in closely to the college's computer science department. Their culture is closer to that of an academic department than it is to an administrative

department. Individuals in academic units set their own agendas; individuals in administrative units follow departmental agendas. Individuals in academic units tend to identify with the technology. Individuals in administrative departments tend to identify with the mission of the department. The result is that there is little commonality in the culture of the two organizations and they must be managed in quite different ways.

- Usage. In the academic computing environment, the user controls the computer. In the administrative computing environment, the system controls the way the computer is used. The academic computing environment has been designed first and foremost as a learning environment. It is designed to require the user to learn a certain degree of technical competency. Second, it is designed to provide the individual user great flexibility in the way that user goes about using the computing tools. Each individual user decides which software to use, what the user interface will be, and what degree of security is required.

  The administrative computing environment is one that assumes very narrow technical competency on the part of the user. It has been designed first and foremost as a reliable and secure system. The system dictates the way the user will interact with it and what functions may be performed. Since the data bases operated by administrative computing are part of the control structure of the University, many constraints are built in to be sure access and use is appropriate to the user's corporate responsibility.

- Networking. Networking is the area where most of the standards work is occurring, and most vendors now support TCP/IP protocols as well as their own proprietary protocols. All networking technologies share common transport media, particulary twisted pair wire, and users want a single network connection to their workstation. It is here that I see academic and administrative computing merging and using a common set of standards for communication.

- Other. There are other differences that tend to be idiosyncratic to a particular campus. Often you find different funding mechanisms in place. One side may charge for service, whereas the other may be subsidized. This makes for far different patterns of use. In some cases, the administrative affairs of an institution may be closely tied to the State or to a Statewide system and this will have an impact on how things are done. For small schools, the sheer cost of the technology may demand a greater degree of sharing.

It is unlikely then, that a common information technology architecture will evolve in the near future. The rigidity of the administrative computing environment would not be appropriate to the academic user. Nor would the academic user be well served by extending the security of the administrative systems to academic computing tools. The result is that there will be boundaries between the two environments. The task, then, is to make these technical boundaries as unobtrusive as possible no matter what the organizational boundaries.

IX. How To Make It Work

Whether we agree with it or not, there seems to be a trend toward combining administrative and academic computing under a single organization. I certainly haven't done an exhaustive survey on the subject, but this trend seems to be occurring in the Big Ten institutions, and in some others across the country. For those of us who work in administrative computing this change may not always be welcome. First of all, it may not be welcome because it is change and most of us are basically uncomfortable with change. Second. we see little commonality of mission as I have already described. And third, these combinations almost invariably wind up under the office of academic affairs rather than administrative affairs. Leaders of such joint organizations receive approbation according to what they do in support of research and instruction, not according to what they do for administration. As a result, there is a concern that funding will be directed to academic computing and away from administrative computing. As I have already shown you, administrative computing at the University of Michigan has not benefited as much as has academic computing.

The more pervasive information technology becomes on the campus, the more demands there are for service from the administrative computing organization. Expenditures for information technology on the academic side of the house invariably lead to increased demands on the administrative side of the house. This occurs particularly in the demand by academic units for making mainframe data available to the workstation. Meeting this need requires different approaches than are required for serving the corporate user. If no increase of funding is available to meet this new demand for administrative data, the administrative computing organization will come under stress. If too much attention is paid to end user computing, the corporate systems user will complain of the draining away of resources intended for centralized systems. If not enough attention is paid to end user computing, the individual end user will complain of the inability to get to the data.

So, given this background, and given that more and more of us are going to be working in organizations that include both administrative and academic computing, what do we need to do to take maximum advantage of the new organizational relationship.

1. Keep communication channels to administrative units open. Administrative users want to know that we still recognize our responsibility for corporate systems.

2. Cooperate as effectively as possible in the networking arena where the sharing of expense is possible and where users are best served by having a single network connection.

3. Share your concerns with your users. For example, if important things are being left undone because of lack of funding, try to get them to help you make the case for increased budget allocations.

4. Avoid redundant support activities where possible. For example, if the academic computing center will support and train users in Lotus 123, then don't support a competing product without good reason.

5. Work for consistent funding and charging mechanisms across all information technology resources. Subsidization encourages the use of resources whether or not their use is the most cost effective for a particular application. A full cost charge back funding mechanism may work as a disincentive for users to make use of central computing resources. Whatever the funding strategy is, it should not serve to disadvantage administrative computing.

6. Take advantage of the partnering that often occurs between information technology vendors and academically oriented computing organizations. In our case, this partnering has enabled us to dramatically increase our mainframe processing power at low cost and to acquire and extensive fiber network. These kinds of partnerships are generally more difficult for administrative units to arrange. This can be one of the biggest pay-offs from a combined operation.

7. Encourage CAUSE, even if it merges with EDUCOM, to preserve some kind of focus on administrative computing so that we can share our concerns and our achievements at a National level.

Conclusion

In summary, there does seem to be a trend toward merging administrative and academic computing departments within a single organization reporting to the academic side of the the house. The argument for this is that these are two similar organizations using similar technology. While I agree the technology is similar, I do not see a great deal of commonality in its use except in the networking area. A great deal of care must be taken in these combined organizations to see that neither academic nor administrative computing is submerged one in the other. The mission of each department must be well understood so that resource sharing enhances rather than undermines objectives.

I know there are some in this room who disagree with what I've said and I'd be happy to hear your thoughts or questions.

Computer-Aided Software Engineering (CASE): Don't Jump on the Bandwagon Unless You Know the Parade Route

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CASE, the latest technique to hit the information systems community, is the topic of national seminars by leading organizations. These seminars exhort us to be on the leading edge of technology by jumping on the CASE "bandwagon". However, like flow charts, data flow diagrams, structured techniques and fourth-generation languages, CASE will only be of benefit if you know exactly what you need and how to integrate it with your present methodology and organization. After all, what is the use of having an expensive, sophisticated tool to help you design and build a poor system faster?

After describing what CASE tools can and cannot do, this paper outlines the impact CASE will have on your project life-cycle and your organization. In addition, a methodology for successfully implementing a CASE approach in your organization is discussed.

1. In the Beginning

In the beginning, there were business problems which users could not seem to solve with the traditional application of people and machines: general ledger, accounts payable, accounts receivable, payroll, registration, student records, financial aid. So, Man created computers. And all was well.

For a while.

Even before apple entered the business, there was temptation. "There is no problem we cannot solve with punched cards, batch updates and tapes", said some. "Data processing is an Art", said others. "Just give us the time to exercise our creativity and our system will last forever."

Then came the fall. "Why does systems development take so long?" asked the users. "Why does it cost so much?" asked the VP, Finance? "Why can't we get it right the first time? Why can't we eliminate the bugs before implementation?" asked the DP manager. "Why is everything always 90% complete? Why can't you measure productivity?" asked the auditor.

What was DP's answer? "Tools. We don't have the right tools."

Fortunately, the 1970's arrived. A brand new tool was on the horizon: structured techniques. Suddenly, software development was to become a Science. Structured English would become the universal language of both users and programmers. Structure charts would allow anybody to understand what a program did and structured programming would reduce testing and maintenance costs by half.

Then there was Ed Yourdon's magic bubble machine: data flow diagrams. Gane, Sarson, and others soon had rival rectangular bubbles on the market. The word structured was suddenly unleashed on the conference circuit. Other fringe groups even contended that the arrows and labels connecting the bubbles had to be precisely to their specifications. Warnier and Orr quickly got ahead of the bubbles and rectangles and pioneered the famous entity/relationship diagrams. Somebody even had the temerity to suggest that maybe a computer could be used to draw these things. So we all threw away our plastic templates. (Except me, I kept mine for the museum).

At the same time, the materials with which we worked improved dramatically. We discovered data bases, on-line systems, disk storage, virtual operating systems and kilobytes of memory.

What were the business problems to which these new tools and materials were to be applied? General ledger, accounts payable, accounts receivable, payroll, registration, student records, financial aid.

Did structured techniques live up to their promise? Probably not, but today, nobody would ever confess publicly that they write non-structured programs or design batch systems. Did the application backlog shrink? Of course not, we just tackled more complex aspects of the same problems. Were we better able to measure productivity and quality? Perhaps we knew a little more about what not to do; but we certainly did not know what constituted quality software. Another decade began, and in the early 1980's James Martin predicted that if we didn't do something soon every man, woman and child in North America would have to become a programmer in order to keep up with the backlog. Eureka, the automation of programming: 4th generation languages were born, along with end-user computing. We invented wonderful new materials with which to work: electronic mail, voice response, PC workstations, relational databases, query languages, colour touch screens, mass storage devices.

What were the business problems to which these tools and materials were to be applied? General ledger, accounts payable, accounts receivable, payroll, registration, student records, financial aid.

What did the users think? "Why does it take so long; why does it cost so much; why can't you get it right the first time; why can't we measure productivity?"

Here we are about to enter the 1990's. What do information systems professionals answer? (Notice we are not called DP anymore.) Tools. This time, we have the right tool. This one will definitely do the trick: Computer-Aided Software Engineering, the solution for the 1990's!

2. The Bandwagon: Understanding CASE

So, what is this CASE? What tools are really CASE tools? What are the promises of these tools? You can read thirty articles and talk to a dozen vendors and you'll have forty-two different answers to these questions. To help unravel the mystery, let us examine the *components* of CASE, the *concept* of CASE tools and the *promise* of CASE.

Software

This the material which we use to build our "bridge" between the business problem and the solution. Software is more than just programs, it includes the documentation surrounding the programs and the data which the programs use. It is distinguished from hardware primarily by its complexity. It doesn't wear out or break like hardware; it just slowly loses its effectiveness over time.

Engineering

This generally implies Science, not Art; and the building of practical solutions. The concepts of discipline, rigour, standards, correctness and re-useable components come to mind.

When applied to software, engineering would be the **tools**, **procedures** and **methodologies** we use to manipulate the software. However, can we really engineer software solutions? Engineering generally deals with static structures and the application of *the* correct solution to a problem. Are the systems we build static structures? Is there only one correct solution to a business problem? Besides, are systems professionals ready to embrace the discipline which engineering demands?

Computer-Aided

Computers got us into this mess, didn't they? Do you really think they are going to help get us out?

At least, they had the sense not to say "computerized" software engineering; the computer is only going to help us, it is not going to solve the problem by itself. This concept has its roots in computer-aided design (CAD) and computer-aided manufacturing (CAM), which, according to many experts, we could not do without today. So there may be hope after all; if a computer can help build an industrial robot, surely it can help build a payroll system.

CASE Tools

If we were truly to engineer software, we would have to provide a fully integrated set of tools which *enhance or replace human activities* throughout the whole systems development life-cycle. For example, these tools would have to be applied to each of the following processes:

strategic planning
analysis and design
prototyping
data management
documentation production
project management
communication
change control and integration
coding
testing
reverse engineering

Depending on your life-cycle approach, this list may not even be complete. However, if you examine the list carefully, you can see that first, almost any software vendor can claim that any of his products is a CASE tool; and second, no one vendor has a tool for every process.

The CASE Promise

In the famous T.S. Eliott poem, Prufrock measured his life in coffee spoons. We seem to measure our lives in life-cycle pies. (Perhaps there is a franchise opportunity here.) You know the ones I mean; showing how much of the life-cycle is spent on analysis, how much on programming and so forth. If you look at a series of these pies over time you will notice that the proportion of time spent on analysis and design has increased, while the proportion spent on programming has decreased (Figure 1). With CASE tools, you notice an even more dramatic change. Some "experts" suggest that only analysis and design will be necessary and that the tools will produce fully tested code. Others, who are more conservative, suggest that only the coding phase will be totally automated.

These changes in the pies are obvious from this figure; but did you notice that the size of the pie itself does not seem to get smaller! In other words, the elapsed time and resources consumed remain the same. So far, we have only shifted the effort to the earlier phases of the life-cycle, rather than reduced the effort overall. Clearly, one of the benefits you would expect from CASE is still to come.

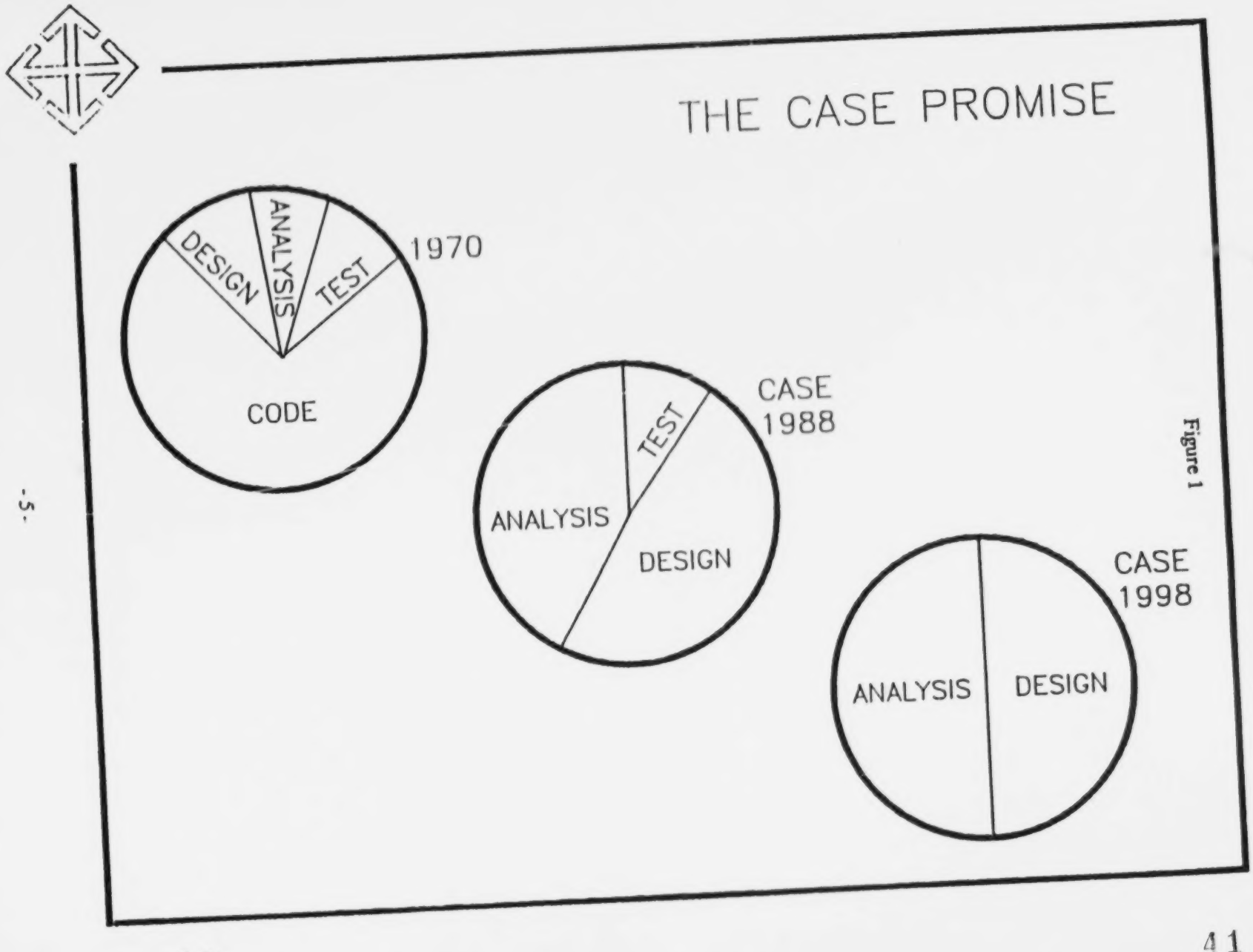

THE CASE PROMISE
DESIGN
ANALYSIS
TEST
CODE
1970
ANALYSIS
TEST
DESIGN
CASE
1988
ANALYSIS
DESIGN
CASE
1998

Figure 1

We know why we have CASE and we know some of what it can and cannot do. Will CASE change your organization? There is no doubt about it. Can you conceive of living without on-line systems to-day? If you can't, you will not be able to conceive of living without CASE to-morrow. James Martin was right. If we are to survive as information systems professionals, we must automate programming. Further, if we are to survive as information systems managers, we must automate the entire systems development life-cycle. Eventually, CASE will do this.

In its current, embryonic state, CASE may not look very promising. Nevertheless, it represents what Dr. Carma McLure describes as a "fundamental change in attitude" and Dr. R.S. Pressman describes as "a multi-disciplinary field that combines management methods and technical methods". Believe it, CASE is here to stay. How are you going to get involved?

3. The Parade Route: Implementing CASE

There have been many articles written and many seminars given on what CASE tools are and how to choose them. Up to know, most of the tools have been produced by specialty software houses, but today the big guns are getting into the business. Digital recently announced a whole "suite" of CASE tools, and Oracle corporation is now touting their version of CASE with the world's best selling relational data base. When IBM finally packages CASE in a big blue box, then we will know it has arrived!

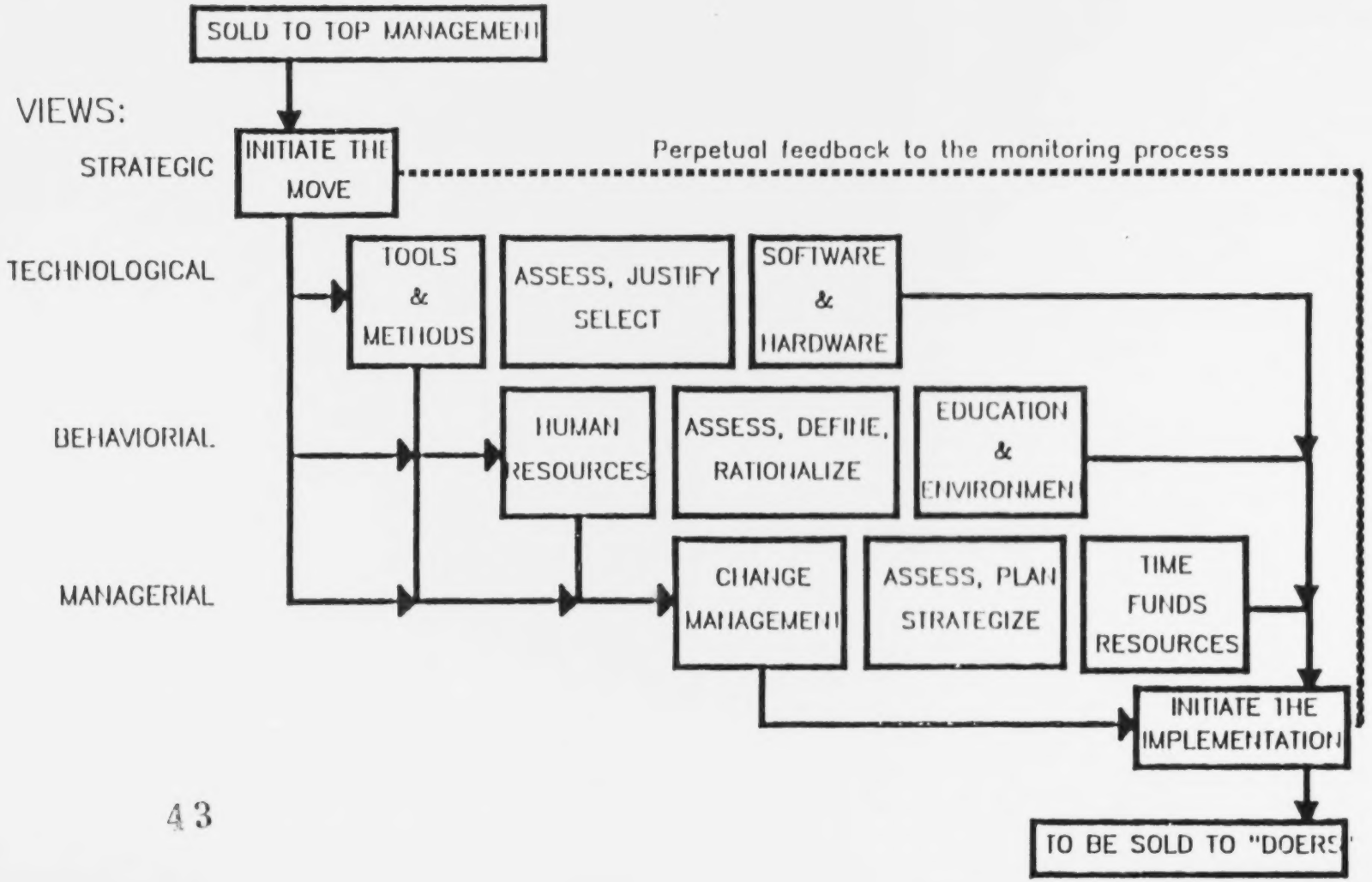
Yet choosing a CASE *tool* is not really the issue. If software engineering means using tools to enhance or replace human activity in all phases of the life-cycle, then an entirely different approach is needed. Figure 2 shows a CASE *framework*, which approaches the implementation of CASE not just from the technological perspective, but also considers strategic, behavioral and managerial aspects. Throughout the process, this approach also suggests a continuous monitoring or evaluation loop, rather than the more common evaluation phase after installation.

What is being proposed here is a complex, integrated process which could completely change your software development life-cycle. The reaction of many managers to such a suggestion is, "I'm too busy with the application backlog to spend time worrying about new approaches". Nevertheless, the first move is up to management. This will not be a one-time technical exercise; it must become an ongoing management challenge, part of the information systems strategic plan. Most of the experts agree that there are certain prerequisites to a CASE approach. If you are unable to manage the three key elements in systems development: people (discipline), process (methodology and tools) and the environment (requirements, scope, business objectives, politics), then CASE will not work as well for you.

From the technological perspective, the goal is to assess, justify and select the appropriate tool set for your organization. This requires at least four separate steps. First, an analysis of the current systems development process is required. Focus on the current state, cost and benefit of the functions, tools, methods and resources you use. Do not spend thousands of dollars automating what isn't worth doing. Second, set the strategic direction. Identify the possible tools and methods which are compatible with where the organization wants to be in the next five to ten years. Third, assess the alternatives and draw up a recommended short list, including a financial assessment. Finally, draw your conclusions. Focus on productivity, profitability and the bottom line. Put together a recommended plan and budget.

CASE IMPLEMENTATION PLANNING FRAMEWORK
GENERAL OUTLINE

Figure 2



From the behavioral perspective, consider first the human resources you will need to operate in a CASE environment. Be careful not to focus just on the use of the tools. Someone will have to manage, maintain, integrate and upgrade them too. A whole new generation of "toolsmiths" will be born. Next, identify the gap between current expertise and that required for CASE. Put together an education plan and a marketing plan. You will have to "sell" many people on the need to change skill sets. Also, beware of underestimating the time, budget and expertise you will need for this selling and education. As Mark Twain said, "A square man cannot be expected to fit into a round hole right away. It takes time to modify his shape". As a manager, you must also realize that while techniques such as newsletters, staff meetings, videos and so forth do transmit useful information, good communication involves listening more than talking.

Finally, from the management perspective there are four focal points in the framework. First, management must take the lead and become knowledgeable about CASE. It must be part of the information systems plan and must be sold to the executives, not just the VP, Information Systems, but the user executives too. This will be no easy task; it is not like a PC and a spreadsheet, from which a user can see immediate benefit. Second, management must fire the starting gun, indicating their commitment to the concept and the process. Third, throughout the process, management must monitor and evaluate, and be willing to change plans and direction as needed. As indicated earlier, this is not a static, one-time exercise. Change management is required. Finally, management must initiate the implementation. Plan big, but implement small!

4. CASE in the 1990's

CASE is clearly growing in the right direction. Already the experts are talking about second generation CASE products. There will be many advances in both the functionality and the technology of CASE. Some of the more interesting aspects to look forward to are the following.

Dictionary Standards

The National Bureau of Standards is working on CASE dictionary standards. If these are implemented, we should see better integration of tools across micros and mainframes, better integration of CASE tools and 4GL tools and the ability to "mix and match" tools from different vendors. Perhaps this will lead to the "seamless" software environment some people are hoping for. Ultimately, this should increase competition and lower prices.

Artificial Intelligence

Ultimately, the dictionary or repository should store an organization's knowledge of the physical environment, allowing automated generation of physical data bases, or risk analysis based on processor capacity or response time. AI could also apply this knowledge from past projects to the project planning phase, or to automate capacity planning.

Automated Testing Before Coding

Some CASE products now boast program testing capabilities; however, the greatest benefits will be gained from automated testing at the design stage, using the business model and data flows. In this way, testing becomes independent of the implementation language.

5. Conclusion

Is it time for you to jump on the CASE bandwagon? Is your organization ready for CASE? Will your systems development staff embrace CASE with open arms?

Unfortunately, all I can leave you with is questions. The next move is up to you.

CASE: Environment, Experiences, Expectations

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Many computing organizations are adopting automated aids to systems development. Among the most promising of these aids in terms of their potential to revolutionize traditional approaches to development are the fully integrated Computer Aided Software Engineering (CASE) tools. The use of these tools can imply much more than simply automating an existing approach to systems development. It requires an approach which is more rigorous, structured and disciplined than that in place in many organizations.

Over the past year, the University of Illinois has acquired and begun using a CASE product. The CASE tool selected, Texas Instruments' Information Engineering Facility, is based upon James Martin's Information Engineering (IE) methodology. Both the methodology and the use of an automated design aid were changes to the application system development life cycle at the University. The IE and CASE environment, the organizational approach to integrating this environment, and experiences resulting from this are discussed. Also, issues relating to expanding the use of this development methodology beyond the start-up group are explored.

INTRODUCTION

The University of Illinois is a two campus institution, with central support for administrative computing. Historically, application systems were developed to meet the needs of a particular customer office. In some cases this led to a proliferation of systems performing the same or similar functions, as well as independent systems which were not interrelated. Although the basic systems are operationally sound, few of these systems provide good management information views. Also, the proliferation of systems, as well as their single purpose focus, requires large maintenance and enhancement efforts against these systems.

To improve the effectiveness of administrative systems at the University of Illinois, three major issues must be addressed. First, administrative systems must be designed to meet the management information needs of the University. Operational systems, while necessary to the functioning of the University, are not sufficient to support the needs of management. This requires an integrated information architecture which allows University information to be viewed as a unified whole, rather than being segregated into administrative and operational systems.

Second, systems must be designed to allow quick response to changes in the University's information needs. This requires a methodology that supports flexibility.

Third, the productivity of the existing systems development staff must be improved. There are a number of aspects to this improvement. The systems developed by the staff must meet the needs of the user community to avoid costly redesign. The development of systems must be accomplished with fewer effort hours. The time span of development projects must be reduced to improve responsiveness to the user community. Finally, the systems developed must require reduced maintenance effort to accomplish inevitable modifications over time.

INFORMATION ENGINEERING METHODOLOGY

METHODOLOGY COMPONENTS

Systems development with the Information Engineering (IE) methodology has seven basic components.

The information strategy planning (ISP) phase supports the definition of the information architecture for a business. The architecture is specified at a general level which describes the information needs for mission critical systems. In addition, ISP provides aids for grouping business functions into logical business areas for development purposes.

The business area analysis component supports the design of a detailed information architecture for a particular business area. This stage of the design details the basic functions and information of one or more application areas, independent of a specific implementation. This results in a design which will be relatively stable over time, since it is independent of current organizational practices. This portion of the analysis provides the building blocks for the later stages.

The business system design component supports the definition of an application system. At this stage, the functions identified in the business area analysis are grouped together to form procedures which will be implemented. Screen design, flow among screens, error processing, etc. are specified at this stage. As specific procedures are added or modified, the changes can typically be effected at this level of design without modification of the basic business analysis.

The technical design component supports definition of the target computing environment, including hardware characteristics and data base management system. Data base definitions are generated automatically during this stage, based on the data analysis done during the business area analysis phase.

The construction phase supports generation of application program and screen code from the specifics of the business system design phase. The work at this stage is highly automated, requiring very little staff effort.

The transition phase is concerned with the conversion from previous practices to the new application environment.

The production phase is the final stage of information engineering in which a system is installed in a production environment.

METHODOLOGY CHARACTERISTICS

Information Engineering is a data-centered methodology. It begins with an information model of an organization which drives all later design phases. The information model is based on a normalized representation of the organization's data, rather than a design based on application procedures or a particular data base management system technology. Data descriptions are stored centrally in an integrated, non-redundant data repository.

Engineering-like methods are used throughout the design process. The design specification process is fully automated, using the central data repository to integrate the stages of design. Design constraints are rigorously enforced in the automated specification process.

Design components are modular and reusable. Common data types are used across the entire business. Common process modules describe the activities performed on the data at the lowest level which leaves the organization's data in a consistent state. All components are maintained in a central repository for use throughout the organization's application systems. Since components of each design stage conform to the same level and type within the information architecture, they are easily used by all components of the subsequent levels.

Information Engineering depends on application of its methodology on an organization wide basis. This is especially true for the strategic systems which form the core of an organization's activities. The methodology requires a high degree of coordination across the entire organization, and a high level of commitment at all levels of the organization.

METHODOLOGY ADVANTAGES

The primary advantage of the information engineering methodology is the establishment of an architecture for application systems. This architecture includes both the information required by the business and the processes that operate on that information. Each system builds upon this architecture, rather than existing as a separate application. This provides a true "data base" environment in terms of eliminating redundancy of data, and supporting a consistent view of information across the organization. The reusability of design, through building upon a set of application components, over time results in the ability to develop additional application functions more quickly as the base of defined information and functions expands. IE also provides organization-wide system integration, since each application uses the same information base.

With the IE methodology, the information architecture is independent of the application designs. As the business organization and procedures change, business applications can be modified without affecting the underlying information architecture and business functional specifications. This provides a flexibility and ease of maintenance not found with traditional application systems.

A result of the concept of a single central information architecture is that the architecture evolves, both as application systems continue to be developed and as the business organization changes. These incremental changes may result in modifications to existing applications, but do not lead to complete redesign.

Information engineering methodology is based on the concept that each business has a core set of information and associated functions which are strategic, that is critical, to the success of the business. It facilitates the development of an information architecture centered around the strategic information upon which management decisions are based.

METHODOLOGY IMPACT

The IE methodology changes the components of the system development life cycle significantly. At the beginning of the life cycle, data analysis is done as a formal design step. This analysis is not application specific, as is a data base design phase.

Process and procedure design replace program design. Again, process design is a more general approach. This is not limited to the application at hand, and, thus, is more extensible to additional application areas that may be developed later. Procedure design more closely replaces program design, since this effort results in the specification of particular screens and programs. Also, a formal definition of the flow among the system components is included at this stage.

Since the data and process design phases are concerned with the basic information architecture and functions required by the organization, the level of involvement of the customer's senior management becomes more significant than with traditional methodologies. The initial analysis stage drives the subsequent application design by providing the key design elements and constraints, increasing the need to complete the analysis stage quickly. Taken together, this makes it essential that techniques along the lines of Joint Requirements Planning (JRP) and Joint Application Design (JAD) be used as a central part of the early design phase. Thus, communication skills associated with JRP and JAD activities become much more important in the project management process.

The traditional data base design stage is replaced by automated data base design and definition. Since the data base design is more or less independent of the information architecture, this stage occurs later in the life cycle and is based largely on the data design rather than the application design. As a result, the data design stages are freed from the considerations of data base design/management constraints and performance tuning.

Significant gains in staff productivity are obtained by automating the routine aspects of system development. However, achieving these benefits depends largely on an organization's ability to deal with associated management issues. A higher degree of customer commitment and involvement at the management level is required in the early design process. A more interactive design environment is required, requiring talented analysts with exceptional communication and organization skills. A more structured environment for managing the organization's information architecture must be developed if organization-wide integration is to be developed.

COMPUTER AIDED SOFTWARE ENGINEERING

CASE CHARACTERISTICS

The Computer Aided Software Engineering (CASE) environment has a number of distinctive aspects, which offer improvements in the systems development process.

CASE tools incorporate graphics oriented design. As a result, these tools are easy to learn. Options are menu driven, typically with mouse selection. This eliminates the need to memorize commands, as well as the requirement to correctly type these commands. Also, the graphic display of design information is self-documenting and easy to understand.

The primary development tools are workstation based. This moves the developer off of the mainframe environment, with its more expensive cycles and potential service outages. Also, it provides better response time for the developer.

The CASE environment supports intelligent enforcement of design constraints and enforces consistency across multiple developers. When working with a CASE tool, the developer is not permitted to specify inconsistencies in the design. This is accomplished through interactive or "on the fly" checking, as well as through comprehensive consistency checking at the completion of each phase of the design. Also, since this checking results in the detection of errors when they occur, the effort required to correct them is much less than if they were discovered at the end of the development cycle.

The stages of the systems development life cycle are integrated in the CASE tool. This interface eliminates the "translation" that occurred in manual systems design, as information was passed from the designer to the analyst to the programmer. Also, it eliminates the redundency introduced at each stage, since the analysis results of each subsequent stage build upon, rather than replace, those of the prior stages.

CASE tools are designed to guide the developer through a structured process. Each step of the development process is well defined, with specific deliverables resulting from each stage.

CASE tools automate routine development activities. CASE tools automatically generate application program code, data base definition statements, and screen definitions. The functions automated are some of the most resource intensive activities. This automation of the routine or mechanical aspects of systems development frees developer time for design activities. Also, it ensures that the generated application accurately reflects the analysis as recorded in the CASE tool.

Finally, CASE tools are rigorous and specific. The developer is required to provide complete and detailed information. Items such as the interrelationships of data fields, the sequence of processes, etc., must be fully specified. In doing this, the developer is required to fully understand and record all aspects of the system. Also, this approach to analysis results in small, detailed specifications at each phase of the analysis. The resulting product is a set of small, concise, easy to understand modules.

CASE ADVANTAGES

In addition to the advantages which result from the individual components of a CASE tool, there are overall advantages which arise from the CASE environment.

CASE tools have a positive effect on the timing and staffing of the systems development life cycle. In the typical life cycle, the longest span of time is devoted to coding. With the CASE tools, this phase of development is much faster, due to automated generation of code. Also, the staffing of the curve is significantly affected. In the traditional life cycle, staffing is low at the start and gradually increases with a peak staffing at coding. With the CASE tools, staffing starts out at a higher initial level, remains relatively constant through analysis, with no increase, and potentially a decrease, at the "coding" stage.

The nature of the testing phase is modified since the developer is no longer testing for coding errors. Instead, logic and design errors are uncovered. Also, the incidence of these errors is reduced due to enforced consistency. Revisions are made in terms of the design, with subsequent code regeneration, rather than making revisions to the code.

At the end of development in the CASE environment, the design must accurately reflect the operational system, since the design is the source for the generation of the system. As a result, documentation which truly reflects the completed application results from the process.

As a CASE developed system moves into the maintenance portion of the life cycle, the advantage of the self-documenting nature of the CASE tools becomes apparent. Since the system design is the source for the application, it is never out of sync with the application. This means that the analysis effort is available as a maintenance aid. Also, since changes are made to the analysis, rather than to the code, the skills needed for development and maintenance are similar.

EXPERIENCES

INFORMATION ENGINEERING FACILITY

The particular CASE tool installed at the University of Illinois is the Information Engineering Facility (IEF) developed by Texas Instruments. This particular CASE tool provides a fully integrated environment. As installed at the University, the analysis and design tools are workstation based, running on IBM PS/2's; the central encyclopedia is mainframe based in DB2; and the applications generated are COBOL II, running in a CICS and DB2 environment. The stated direction for the IEF product is to produce portable, SAA compatible systems.

The IEF currently supports the development of on-line applications only. Also, there is little support built into the tool for the transition and production phases. The primary focus of the IEF is the first five components of the IE methodology.

ORGANIZATION

When the IEF was introduced at the University, Administrative Information Systems and Services (AISS) made an organizational commitment to the CASE environment. Staff were assigned full-time to work in the CASE environment. Significant funding was devoted not only to the purchase of the IEF, but to provide equipment and staff training. Time was committed to allow for a learning curve and adaptation to the new environment. This approach was significantly different than that taken with the introduction of various software packages in the the past, in terms of a management commitment. This commitment is vital to success in the introduction of a CASE environment.

AISS carefully selected staff to assign to the CASE team based on expectations of their success with it, rather than on current availability. The initial team was composed of one manager, three senior level analysts, and one inexperienced analyst. The emphasis on senior level analysis skills was due to the fact that the CASE environment provides an analyst workbench. It is not a programming environment. One inexperienced team member was chosen to determine how easily a new analyst could develop skills working in this environment. Organizationally, the group was placed in a special projects area, under the direct supervision of that area's manager, who also functioned as a team member. Placement in this area insulated the group from ongoing operational concerns of existing systems.

In evaluating the team selection, after about one year of work, it is clear that analysis skills are the key issue. Although the CASE environment enforces consistency in design, there is nothing in the tool which can prevent the developer from simply misunderstanding the needs of the customers. Unfortunately, the inexperienced team member left the University shortly after training had begun. At that point, an additional senior staff member was added to the team as a replacement, since it was felt that a senior analyst would be better able to "catch up". Consequently, the effect of the CASE environment on developing analysis skills has not been evaluated.

PILOT PROJECTS

The initial pilot project for the CASE team was the redevelopment of a work request and task tracking system used internally by AISS. This project was chosen because the existing system was inadequate, the scope of the project was limited, the risk associated with the project was minimal, it was primarily an on-line application, and there was no required deadline. The resulting system, which is in the conversion stage, consists of 15 DB2 tables and 71 CICS programs.

In reviewing this project, the major drawback was the size of the system. This error in size occurred because, although the application being replaced was small, in doing a thorough analysis it became clear that the business requirements were far more complex than had been supported previously. This points up the strength of the environment as an analysis aid in supporting a complete understanding of the application requirements. However, implementation of a smaller application would have more quickly demonstrated successful results.

A second pilot project, which involves a customer application is also under way. This project involves the development of a personnel system to support the civil service hiring procedures of the University at both campuses. This project is in the business system design phase.

In working with customer staff, the major difficulty encountered involved communication using the standard products of the IEF (i.e. reports, diagrams, etc.). Many of the diagrams produced, particularly for data design, were foreign and confusing to the customer. It became clear that communication with the customer needed to focus more closely upon the processes and functions to be supported, rather than on the underlying information architecture. Also, there was a temptation by the CASE group to describe their work in the terminology of the IE methodology. This change in language added to customer confusion. In introducing a CASE environment, a change in the language used to communicate with customers must be avoided.

EXPECTATIONS

The choice of strategic application areas will be a major issue in the overall success of CASE. By developing an architecture for primary, strategic systems, the University will be building the framework for its information needs and for the development of applications. Some of the major gains to be realized from the CASE environment come after this foundation is created. This allows additional applications to be quickly developed, since they build upon these basic components, which results in increasing gains in efficiency. Also, the resulting information architecture should meet the central information needs of University management.

AISS must carefully manage the information architecture to ensure that a common foundation is developed, rather than a "crazy quilt" of individual applications. Without central control and coordination, the CASE environment becomes little more than a faster programming language. With central management, the development of each application builds upon those previously designed, again resulting in efficiency improvements. Also, this reduces maintenance requirements by eliminating duplicates, which must be separately maintained and coordinated.

In the CASE environment, the central encyclopedia serves as the corporate repository for applications. The management of this resource is critical to ensure an accurate reflection of the architecture and applications being developed. Since the central encyclopedia is the source for applications, damage to it can interfere with existing CASE-developed applications, as well as with future development.

As the CASE developed architecture grows, training and staffing for CASE development will be an ongoing concern. At this point, the learning curve for an experienced analyst appears to be about six months, primarily due to differences in methodology. Given the length of the learning curve, assignment of dedicated staff is critical.

There are a number of staff morale issues surrounding the introduction of the CASE environment. Some staff view the CASE environment as threatening. For those who have a solid expertise in traditional development and technology, there is a fear of the unknown. Also, staff assigned to the ongoing maintenance of older systems may resent those assigned to "new development" in the CASE environment. Over time, this should become less of an issue as maintenance of CASE developed systems stays within the CASE environment, and as older systems are replaced.

Of particular concern is the role of programming skills in the CASE environment. For those staff assigned primarily to writing computer application code, there is skill obsolescence. Some will view CASE as an opportunity to gain new skills, while others may be unable to adapt. Given that all systems will not be converted immediately, this is a long term issue. However, the retraining of programming staff to perform analyst functions may require a long period of time, so planning cannot be deferred indefinitely.

For all staff working in the CASE environment, communication skills become more critical. As the "back room" functions of development, such as coding and unit testing, become more automated, the customer contact functions will require a greater proportion of staff time. In a sense, this shortening of the development cycle moves the analyst closer to the customer.

CASE also has an impact in terms of customer involvement in development. Since the development cycle is compressed, the customer must be prepared to commit a greater proportion of time during the time frame of the project. This can be a difficult adjustment for customers who are accustomed to having the developer spend weeks preparing documentation resulting from a brief session. Since most customers have ongoing responsibilities aside from the development project it can be difficult for them to devote sufficient time to a CASE development effort.

CONCLUSION

Although there is a temptation to view the CASE environment as the "bleeding edge" of computing at this point in time, the methodology and toolset is available, and success can be achieved now. The single key factor to achieving success is commitment. This includes commitment to a development methodology, management commitment, and staff commitment to success. While the CASE tools will become more complete as time passes, the issues of organization adaptation will not disappear. Staff will require time to grow into the CASE environment. By starting now, an organization can be positioned to grow with the CASE environment.

Telecommunications as the Umbrella for Managing the Linkage and Integration of Resources: A Practitioner's View

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ABSTRACT

This paper summarizes the development of a comprehensive five-year strategic plan for linking and integrating several currently disjointed information resource communication systems using the umbrella of telecommunications. A broad range of programs and services are encompassed in this study, including emphasis on areas of energy management and surveillance and security. Additional areas of focus are voice communications, data communications, video communications, office automation, administrative computing, and instructional computing. The end product of this study is a strategic master plan which presents an infrastructure of telecommunications, computing, information systems, surveillance, security, and energy management. The plan describes in detail the integration of separate aspects of these systems.

INTRODUCTION

This abstracted version of a longer paper succinctly describes how one institution is preparing to meet the demands of the ever-emerging information society. Senior executives of the institution realize that in order to reach virtually every desired university goal and objective, there is a related need to improve the technological base of the campus. Presented here is a summary of a comprehensive five-year strategic plan for such improvements, which involves the full scope of telecommunications programs and services. Some objectives of the strategic plan are to:

* Establish telecommunications as a foundation for information;
* Embrace the philosophy of user-driven and distributed computing;
* Increase decentralization of access to information processing resources;
* Integrate network based applications, such as voice, data, video, energy management, surveillance and security;
* Accommodate new applications such as electronic mail, computer conferencing, bulletin boards, etc.

The plan is designed to assist the senior leadership and the governance structure for telecommunications in understanding and developing plans and strategies for more fully utilizing the complete spectrum of information resource technologies to the benefit of the entire university community. It is flexible and suitable for adoption by other universities or institutions desirous of a workable strategy for linking and integrating computing resources.

STRATEGIC APPROACH TO LINKING AND INTEGRATING RESOURCES

Strategic Thinking

Without a doubt, strategic thinking paved the way for the development of Grambling State University's (GSU) five-year strategic plan for information resources. Administrators recognized that we are rapidly becoming an information society in which changes in our way of doing things are no longer occurring in the usual evolutionary manner, but rather in a revolutionary manner. GSU sought to prepare for the information society by establishing telecommunications as the foundation for computing and communication.

The preliminary foundation building for this task began in 1979 when GSU secured state funding for a "New and Expanded Telephone System" (State Project, 1979). As the title implies, this $850,000 project expanded the

scope of communication services in some areas and made new services available to other areas. At the same time, provisions were made for future growth and expansion although the idea of telecommunications as an umbrella had not yet been envisioned.

However, in 1984, three years after implementing its first five-year plan, GSU recognized the need to establish telecommunications as the foundation for information resources. The university wanted to dismantle the existing system of information resource management which was nothing more than a fragmented collection of public utilities and relics of a 1940's campus communication system. It was at this point that the university set two major goals for itself. These were 1) to plan and organize for effectiveness and 2) to establish telecommunications as the foundation for computing and communication.

By 1986, in the second iteration of the planning cycle, strategic thinking had become even more important. In fact, it was determined to be one of the four major strategies for improving management capabilities at GSU. Strategic thinking resulted in the development and eventual funding of a major grant to implement an enhancement activity referred to as "Strengthening the Linkage and Integration of Computing Resources." This developmental program has evolved into a fairly extensive telecommunications and information processing environment.

In addition, GSU has, over the last five years, implemented a plan to improve the computer support for administrative operations by expanding its on-line, interactive capabilities and by developing an hierarchy of information systems (HIS/MIS). The impending installation and development of a "VAX Family" will significantly decrease the practical limitations on the number of simultaneous, on-line administrative users which can be accommodated. The HIS/MIS has enhanced and strengthened GSU's management capabilities by providing the information necessary to support all levels of administrative activities.

During the planning and implementation of these first telecommunications/computing improvements, GSU's executive management was astute enough (thought strategically enough) to recognize even larger needs and, as a result, expanded the scope of its vision. We decided to plan for revolutionary rather than evolutionary improvements in the information resources and management capabilities of the university. Instead of allowing computing and communication resources to remain disjointed, the idea was conceived to totally reorganize computing and communication under the umbrella of telecommunications.

Conceptualization of the Telecommunications Umbrella Within the 7-S Framework

At GSU, we espouse the viewpoint that a strong foundation for excellence can be established by pursuing a number of important strategies. One of these strategies is the adoption of McKinsey's 7-S Framework as a planning paradigm (Lundy & Carter, 1988). The 7-S Framework has the appearance of an atom with seven factors, all beginning with the letter "S" (Peters & Waterman, 1982).

Using the seven elements of this model, we assessed our current computing and communications resources and determined our needs. In other words, the Telecommunications Strategic Plan is a blueprint for improvements in efficiency/effectiveness consisting of an analysis of the 7-S elements: 1) superordinate goals or shared values, 2) strategy, 3) structure, 4) systems, 5) staff, 6) skills, and 7) style. A brief synopsis of the analysis is presented below. (Further explanation of the 7-S Framework is included in a longer version of this paper.)

Superordinate Goals (Shared Values)

GSU's shared values embrace the motto that "GSU is the place where everybody is somebody!" This philosophical statement accentuates the university's commitment to students who have been adversely affected by educational, social, and economic deprivation. The philosophy also extends to the university's treatment of faculty, staff, and other constituents. More importantly, this foundational tenet establishes the sound basis from which we build GSU's institutional culture.

Another shared value which is specifically related to GSU's vision for telecommunications is highlighted in the Statement of Institutional Mission and Philosophy. It states that "GSU strives ...to strengthen its institutional effectiveness and academic programs by developing and implementing new and enhanced informational technologies..." These shared values are the base from which the remaining 6-S's emanate.

Strategy

Linkage and Integration of Information Resources (Computing)

In its preparation for the "Information Society", GSU must adopt carefully chosen long-range strategies and short-range tactical plans to achieve a sufficient degree of information processing intensity to ensure the survival of the institution. An essential strategy in achieving this goal is to link and integrate GSU's computing resources. Furthermore, GSU is convinced that it can achieve its goal by embracing the philosophy of user-driven computing. One of the keys to developing this new environment involves replacing the traditional telephone and computing delivery systems with an integrated voice, data, and video system that facilitates distributed computer applications. GSU is committed to planning for an environment of increased decentralization of access to information-processing resources which require a shift in emphasis from centralized facilities to the use of terminals and microcomputers on every desk top. Obviously, the implementation of decentralized access and distributed-computer applications will require a basic definition of computer literacy for students, faculty, and staff. Ultimately, GSU hopes to create an extensive environment of academic and administrative computing supported by a networked configuration of mainframe computers, minicomputers and microcomputer laboratories. These components would support enhancements which incorporate the new information technologies.

The university has been engaged in a program to strengthen its management capabilities and to enhance services to Academics, Student Services, Administration and various other clientele. Over the last four years--in order to acquire an infrastructure of computing and telecommunications equipment--GSU has expended approximately 5.2 million dollars.

Another fundamental strategy in achieving the linkage and integration of computing resources has been the completion of GSU's comprehensive strategic plan for information resources. State funds were secured to engage a nationally known computing and telecommunications firm to assist the university in this effort. This plan is extensive and includes many aspects of the current planning process. A discussion of these planning components is presented in the section titled "Developmental Plan for Telecommunications." Specific strategies, however, are described below.

The Vice President for Administration and Strategic Planning has the primary responsibility for the derivation and completion of the plan. Additionally, he assists the Director of Computing and Telecommunications in developing and implementing the activities associated with the plan.

Many of the projects recommended in this plan to fulfill the future needs of GSU and its sub-units mandate incremental funding beyond the university's current "budget base." Therefore, critically needed Title III funds totalling 1.5 million dollars were provided to support the implementation of the following strategies:

1) Implementing an integrated voice, data, and video Local Area Network (LAN);

2) Installing an outside cable plant using fiber optics technology;

3) Acquiring and linking (clustering) a VAX 8350 computer with other VAX computers ("Vax Family");

4) Establishing a Computer Information Center;

5) Upgrading existing computing hardware and software; and,

6) Developing and implementing a training program in computer literacy for academic users.

To ensure that all of these strategies are successfully implemented, the university's Network Task Force will monitor the progress on levels of achievement. As structured, the Task Force has broad representation from each major functional area of the university. The Senior Director of Computing and Telecommunications is chairman of the Network Task Force.

Since GSU's vision of the future is a totally integrated environment characterized as network-centered, workstation-based, server-enhanced, and software-integrated, two more equally important strategies had to be pursued:

1) Encouraging South Central Bell to replace its obsolete Step-Mechanical Switch in the Town of Grambling to ensure interface capability with GSU's enhanced technological base; and

2) Convincing the Louisiana State Office of Telecommunications Management (OTM) to serve on GSU's Network Task Force.

South Central Bell finally upgraded the Telephone Exchange Building and the switch for the Town of Grambling in 1986. However, South Central Bell's positive response occurred only after numerous admonitions from GSU's executive management and OTM, one of the university's state governance structures.

Related to the second strategy, GSU had to pursue any expedient and legitimate course of action which could lead to the allocation of additional resources to the institution's coffers for information resources. Thus, OTM officials were invited and strongly encouraged to serve on the university's Network Task Force. In fact, the Assistant Director for Administration and the Customer Services Officer of OTM are permanent members of the Network Task Force. We believed that their presence on the Task Force would place them in a better position to understand GSU's needs and priorities, and that they would subsequently, provide the support the university needed to secure additional funds for development of the telecommunications master plan. This relationship also served to improve the level of commmunication and the rapport between GSU and this important state agency.

Structure

As might be expected, a change in direction (superordinate goals) and new strategic approaches (strategy) quite naturally lead to structural alterations. GSU's vision for information resources demanded that the old fragmented computing and communications organizational structures be changed. At one time computing resources were under the control of the computing center. However, the technical aspects of telecommunications were housed in the physical plant. Switchboard operations reported to Auxiliary Management and communications reported to the Vice President for Administration.

Under new vice presidential leadership (1986) it was decided that there should be a merger of these functions. The new organization integrates the disjointed aspects of information resources under the single umbrella of Telecommunications and Computing. This merger was viewed as the most effective and cost efficient way to achieve the major planning strategy of establishing "telecommunications as the foundation for computing and communication at GSU" (Lundy, 1986). The rationale for this strategy lies in the recognition that increasing decentralization of access to computing resources means that campus computing centers must become more closely integrated with campus telecommunications systems.

Developmental/Support Committees

Also related to structure is the establishment of telecommunications developmental/support committees. These committees were set up to perform strategic analyses of relevant issues and communicate the results to executive management providing the information needed to make strategic decisions. The committee structure evolved from an original 6-member team charged with developing a plan for improving the telephone system to a 28-member group charged with the responsibility of 1) developing policies and procedures for information systems, 2) establishing priorities for the development of new and existing components and devices in the new networked environment, and 3) ensuring the linkage and integration of information resources. (A more detailed discussion of the evolution of developmental/support committees is presented in a longer version of this paper.)

Policy and Procedures

Along with structural changes also come policy and procedural considerations. One major policy issue emanating from GSU's Telecommunications Strategic Plan has resulted in revisions to State policy. OTM entered into an agreement with GSU which allowed the installation of a telephone node in every new building on campus. Also, GSU was able to convince State Facility Planning and Control to include station wiring as a mandatory aspect of the cost of new construction.

Our vision for telecommunications also led to GSU becoming its own utility company. This, of course, resulted in other policy issues. For instance, policy had to be developed related to our state of self-sustainment; policy had to be developed to cover the establishment of another auxiliary enterprise (i.e., a new budget unit); policy was needed to govern pricing procedures and to institute cost recovery systems for selected telecommunications programs and services.

Another major policy issue revolved around the acquisition and use of equipment at GSU. Policies and procedures were established to implement a local area network based on use of the Ethernet TCP/IP protocol. As such, the university could maximize use of existing resources and eliminate the prerogative to acquire any device not usable in the ultimate configuration. Consequently, all instructional and administrative systems host computers at GSU will support an Ethernet composite interface. Other policy issue continue to emerge and resolutions are forthcoming.

Systems

History of the Telephone System

Prior to 1984, GSU's voice communication was supplied by an antiquated cable plant and switch which were installed in the 1940's. This outdated technology greatly limited the university's ability to provide basic telephone services.

Shortly after assuming leadership of GSU in 1977, the new administration formulated strategies to replace the obsolete telephone system. A telephone system committee was appointed to study and recommend preliminary plans for a new and expanded telephone system.

The proposed plan of the committee (submitted on October 29, 1979) was accepted by GSU's executive management and converted into a capital outlay project entitled "Improvement and Expansion of Telephone System." This two-phase capital outlay project called for a complete overhaul of the telephone system.

Funds for the project were provided via Legislative appropriations. The appropriations also paid for a Cable Plant and a Telephone Exchange Building which were erected during the time span of 1981-1983.

Recent and current enhancements to the telecommunications system have been made possible by a supplemental appropriation of $800,000 to a project entitled "Energy Management, Telecommunications, Surveillance and Security Systems." With these funds, two recent additions were made to the outside cable plant. Also, a current enhancement involves installing a fifth VLCBX node to temporarily resolve a capacity problem.

It is important to mention that the ROLM VLCBX was purchased from Centel--the only authorized distributor of ROLM products in Louisiana. As an initial strategy, executive management decided to consummate a contract with Centel to maintain and to operate the switch and the cable plant for fees totaling $150,000 per year. This decision was made because GSU did not have enough expertise in telecommunications when both phases of the project were completed in the Fall of 1984. A discussion of GSU's strategy for acquiring permanent technical expertise appears in the section titled "Skills/Staff".

Current Voice Communication System

Voice communications services are provided to GSU faculty and staff as well as to students who reside in campus dormitories. There are about 2,500 stations in operation at this time, with station sharing in effect in some instances.

GSU installed a four-node ROLM VLCBX (very large computerized branch exchange) PBX system on campus. Technical and procurement support were provided by the Louisiana State Office of Telecommunications Management. The VLCBX nodes are co-located in the PBX Telephone Exchange Building. This centralized distribution of telecommunications services corresponds to the outside telephone cable plant also centrally distributed from the Telephone Exchange Building.

Since the initial PBX installation in 1984, there have been only a few additions and upgrades. These additions and upgrades to the PBX include the following:

* Additional extension motherboards and associated eight channel extension cords to increase the extension equipped-for capacity to approximately the maximum wired-for capacity of the system.

* Recent system applications upgrades which include: forced authorization codes (FAC) and call detail recording (CDR)

* The addition of various manufacturer specified corrective software patches for the system.

A new outside telephone cable plant was installed at the same time as the ROLM PBX. This consisted of 24 American Wire Gauge (AWG) direct buried Alpeth feeder cables to each building. New outside telephone cable termination pedestals were also added. In addition, a new main distribution frame (MDF) with 66 type connector blocks, corresponding lightning protection modules, and new intermediate distribution frames (IDFs) with corresponding interframe (MDF to IDF) cabling were installed in each building.

Since the initial GSU campuswide cable plant was installed, two additions were made to the outside cable plant. These included the implementation of a telecommunications manhole, multi-duct 4" PVC conduits, and 1200 pairs of 24 AWG Alpeth cable.

Telephone System Upgrade

GSU's existing PBX is operating at 97 percent of its extension capacity. Therefore, the university is currently unable to provide additional lines to meet the ongoing day-to-day requests for service.

To temporarily resolve this capacity problem, a fifth VLCBX node for GSU has been ordered. The new node will increase the telephone extension capacity as well as the trunking capacity.

ROLMphone telephone stations (voice only and integrated voice and data synchronous/asynchronous) will replace the currently used ROLM electronic telephone sets (ETS) and will also introduce integrated voice and data switching through the PBX. Terminal devices will primarily access the academic host computer system (i.e., VAX 11/780). A few of the terminal devices will support administrative users accessing the administrative host (i.e., DEC PDP 11/70, PDP 11/84).

The reconfiguration required for the addition of the new node will upgrade the VLCBX system software to Release 9004. ROLM route optimization software will also be installed in the upgrade providing the VLCBX with the intelligence to select the most cost effective routing of calls placed over GSU's trunking facilities.

Future System Needs/Requirements

Even though GSU has installed a PBX system, the existing operation does not reflect a corresponding expansion of function, operation, or management in terms of scope and depth. This is partially due to the controls at the State level.

Fourteen major needs/requirements evolved from developing the telecommunications plan. (Each is more fully described in the full length

version of this paper.) Planning, implementing, and operating the utility now and as it will evolve over the next several years will require managerial as well as operational changes in order to move toward full functional utility.

Skills/Staff

It is a well known fact that IBM acquired ROLM to provide the technological capability it greatly desired to have in voice communication. On a much smaller scale, GSU pursued a similar strategy.

After GSU's one-year maintenance and operations contract with Centel had expired, executive management proceeded to implement the strategic decision to acquire permanent expertise in telecommunications by hiring Centel's certified ROLM technician. A successful strategy included an offer to double the technician's existing salary. Without hesitation, the former Centel technician decided to "secure his future" with the place "Where Everybody is Somebody."

The decision to hire Centel's telecommunications technician was a major step in consumating executive management's plans to merge the telecommunications and computing functions and to create GSU's own Telecommunications Utility. Executive management gave two fundamental reasons for merging voice and data communications: 1) the well-documented trends in merging or converging technologies (voice, data, and video); and 2) the well-documented trends in commonality of transmission media (broadband, fiber optics, twisted pairs, etc.).

Moreover, executive management understood how improvements in technology have allowed voice communication to move from analog processing to digital processing. Voice signals could be digitized and processed in the same manner as data. Therefore, executive management was convinced that the university's Telecommunications Utility must be staffed by "technocrats" who possessed excellent skills in computing. Thus, the Director of the Computer Center became Senior Director of Telecommunications and Computing. Two additional "technocrats" with computing skills were hired primarily for the telecommunications function. They received on-the-job training in the fundamental functions of a Telecommunications Utility (installing telephones, pulling lines, etc.).

Executive management also understood that for the university environment to function smoothly and cooperatively, there had to be an appropriate mix of "technocrats and bureaucrats." Therefore, in recognition of this principle, a Telecommunications Liaison Officer was appointed. This bureaucrat had to have good public and human relations skills to be able to perform a myriad of duties.

Style

GSU's style of management is best explained via an excerpt from the University's Statement of Institutional Mission and Philosophy.

"GSU strives... to create an environment where participatory management is an accepted organizational norm..."

We have adopted a decentralized, egalitarian approach to management that is participatory and objective oriented, i.e., management by objectives.

Developmental Plan for Telecommunications

With the above 7-S analysis of our needs and desires in place, we were ready to put together a strategic master plan for telecommunications. Every conceivable aspect had been considered. However, in order to check and verify, to add further credibility, and to reduce the probability of state-level bureaucratic resistance, external consultants were contracted to write the final version of the plan.

The consultants, Systems and Computer Technology Corporation (SCT), followed the lead already paved by the on-going strategic planning process at GSU and our assessment of the plan's scope. In addition, the consultants conducted an extensive review of existing internal documents along with interviews with a cross-section of university personnel to establish a base of information from which to produce the final plan. Additional interviews were conducted with representatives of various state offices and information relating to how other institutions are solving the network requirement that results from the integration of individual application area needs was collected and analyzed. Combined with the specific needs of GSU, this aggregated information was used to develop the strategic plan.

The consultants analyzed four basic areas in determining the ideal telecommunications needs for GSU. These included: 1) a review of relevant trends affecting the nature and scope of information resources in higher education; 2) the completion of an environmental scan (assessment) of the university's internal and external environments; 3) a user needs assessment; and 4) an inventory of current and future computing system needs. A synthesis of information from these four sources established the foundation for an assessment of the integrated user needs as well as the integrated functional needs. The needs, of course, determined the network design approaches.

Other developmental aspects of the plan included: 1) the articulation of a functional mission statement, 2) the relationship between university goals and plan goals, 3) administrative goals, 4) operational goals, and 5) planning assumptions and strategic guidelines. These aspects of the plan are described in a longer version of this paper.

PROJECT SCHEDULE AND BUDGET INFORMATION

Exhibit 1 shows the anticipated sequence for implementing the technical projects described throughout the Telecommunications Strategic Plan. The sequence is based upon a year-by-year progression toward arriving at the

desired campuswide improvements to the existing and installation of the new and integrated communications utility. It is not intended that one project be completed before another is begun, but rather that several projects be in progress at the same time depending upon resources and capable project management.

[Insert Exhibit 1 here]

With regard to budgeting parameters, it is estimated that all projects may be completed for approximately $750,000. This figure does not include total expansion of the campuswide LAN. It is estimated that each workstation added to the LAN will cost approximately $650 per hookup, not including the cost of the actual workstation itself. Individual cost estimates are included within the project plans where applicable.

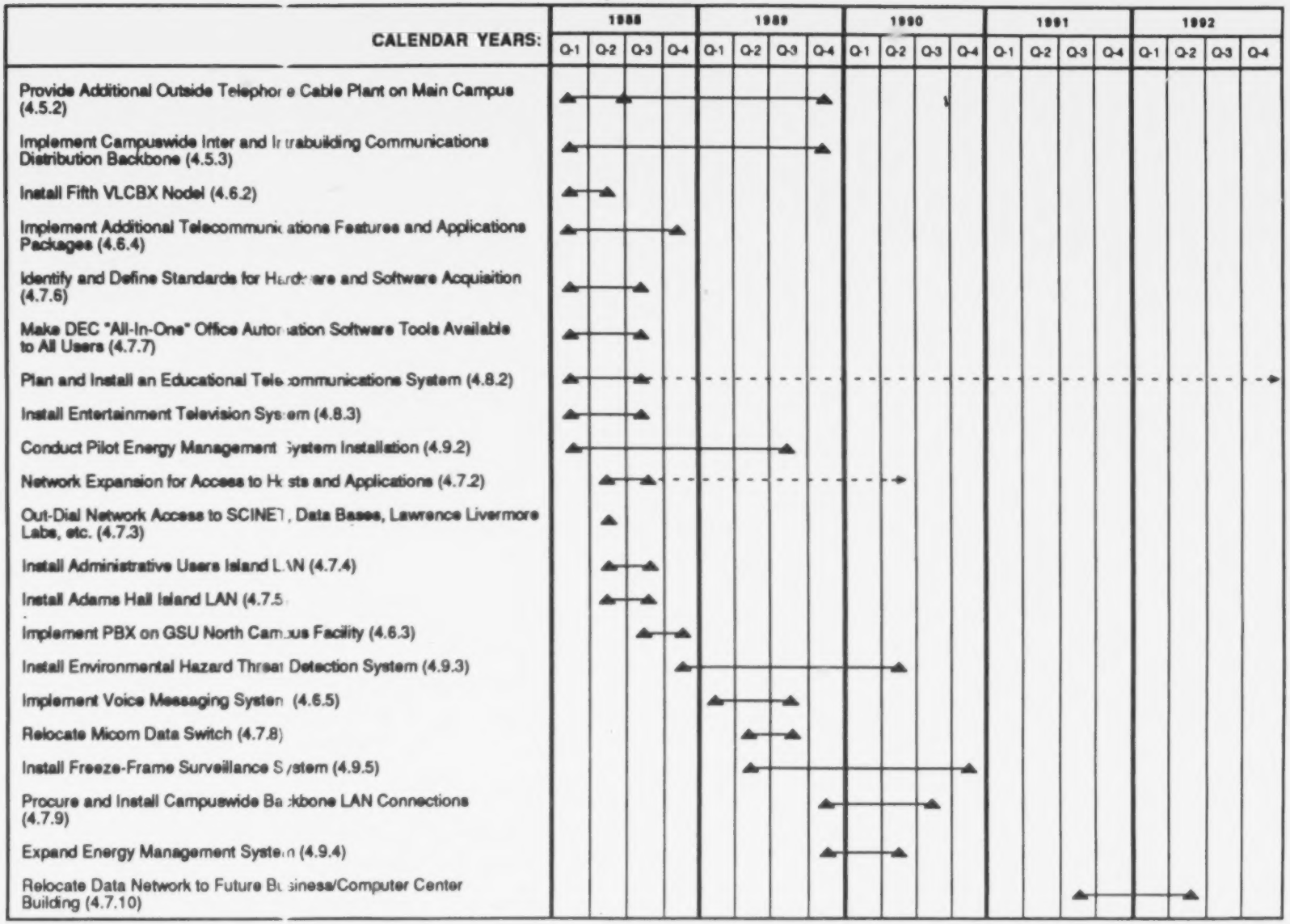
SUMMARY AND CONCLUSIONS

The purpose of this Plan is to serve as a roadmap for the development and implementation of GSU's telecommunications network for managing the linkage and integration of resources. The **"umbrella"** theme departs from the traditional computing dominance and terminology that is being phased out at some of the more progressive higher education institutions. It will take some rethinking and relearning on the part of most campus personnel to become acclimated to the newer focus. There are additional campus support services and functions that may be considered for inclusion under this umbrella over time -- and, in fact, the more technologically sophisticated the GSU environment becomes, the wider the range of coverage of the umbrella.

While the overall perspective of the telecommunications framework or umbrella is a theme, an underlying but significant emphasis within the Telecommunications Strategic Plan is to provide smaller-scale, shorter-term, and flexible project plans. Implementing these plans will incrementally move the campus into the desired telecommunications environment at a measured pace and within reasonable spending parameters, while at the same time propelling the institution along its path toward "Creating and Achieving Excellence in All Programs and Activities."

EXHIBIT 1

Project Schedule


CALENDAR YEARS:
1988
1989
1990
1991
1992
Q-1 Q-2 Q-3 Q-4 Q-1 Q-2 Q-3 Q-4 Q-1 Q-2 Q-3 Q-4 Q-1 Q-2 Q-3 Q-4 Q-1 Q-2 Q-3 Q-4
Provide Additional Outside Telephone Cable Plant on Main Campus (4.5.2)
Implement Campuswide Inter and Intrabuilding Communications Distribution Backbone (4.5.3)
Install Fifth VLCBX Nodel (4.6.2)
Implement Additional Telecommunications Features and Applications Packages (4.6.4)
Identify and Define Standards for Hardware and Software Acquisition (4.7.6)
Make DEC "All-In-One" Office Automation Software Tools Available to All Users (4.7.7)
Plan and Install an Educational Telecommunications System (4.8.2)
Install Entertainment Television System (4.8.3)
Conduct Pilot Energy Management System Installation (4.9.2)
Network Expansion for Access to Hosts and Applications (4.7.2)
Out-Dial Network Access to SCINET, Data Bases, Lawrence Livermore Labs, etc. (4.7.3)
Install Administrative Users Island LAN (4.7.4)
Install Adams Hall Island LAN (4.7.5)
Implement PBX on GSU North Campus Facility (4.6.3)
Install Environmental Hazard Threat Detection System (4.9.3)
Implement Voice Messaging System (4.6.5)
Relocate Micom Data Switch (4.7.8)
Install Freeze-Frame Surveillance System (4.9.5)
Procure and Install Campuswide Backbone LAN Connections (4.7.9)
Expand Energy Management System (4.9.4)
Relocate Data Network to Future Business/Computer Center Building (4.7.10)

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PLANT OPERATIONS IN TRANSITION: A CASE STUDY IN THE MANAGEMENT OF CHANGE

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To protect its almost $6 billion investment in its 19-campus physical system, the California State University embarked upon a major program to replace its fragmented, manual plant operations processes with a highly integrated on-line Maintenance Management System (MMS). A review of those forces behind the effort to automate a largely neglected, benign organization such as plant operations is then followed by an analysis of the massive changes in plant operations. Finally, the improvements - both direct and secondary - are described in terms that might apply to any successful effort which imposes a complex, computer-based system on an environment of reluctant participants.

THE ENVIRONMENT

The California State University is a system of higher education which satisfies that large segment of students between the community colleges and the more selective research-oriented universities. Supporting an enrollment of over 350,000 students, the citizens of California have entrusted the California State University (CSU) with an endowment of more than six billion dollars invested in over 1,000 buildings and related equipment to support the educational mission. Like much of the infrastructure in the United States, these facilities are deteriorating at an increasing rate. Approximately half of the CSU's facilities were built over 30 years ago. The internal support systems in these older buildings are obsolete compared to the high technology now available. Budgetary non-emergency tasks have been deferred again and again. If future generations are to enjoy the benefits of a satisfactory educational environment, this endowment must be better protected and cared for through more aggressive resource management.

The California Legislature recognized the need to protect this investment, and in supplementary language to the 1979/80 State Budget Bill expressed the belief that this protection could best be accomplished through a systemwide policy of preventive maintenance. Since that budget bill was enacted, the CSU has made facilities maintenance a primary goal. A substantial effort on the part of campus and central office administrators has resulted in demonstrable gains throughout the Universities. The Work Control Center concept, computerized preventive maintenance, and a 5-year plan for programmed maintenance have been implemented on every campus. The Maintenance Management System (MMS) is the capstone of that effort.

THE ROLE OF PLANT OPERATIONS

Plant operations is a service organization responsible for the maintenance and repair of the campus, which includes all structures, basic building components, utilities, grounds, roads, and parking lots. In the CSU, maintenance is defined as the work necessary to keep all state-owned facilities in good repair and operating condition. These services include: utility systems (electricity, water, gas, heat, ventilation, air conditioning, plumbing, sewage, and elevators); and maintaining and repairing basic components of buildings and grounds (foundations, walls, roofs, stairs, ceiling, floors, floor coverings, doors, windows, hardware, turf, sidewalks, streets, trees and equipment).

This maintenance definition specifically excludes new construction and alteration of existing facilities, such as, adding decorative treatment to buildings and grounds, attaching items to buildings, extending or modifying utility systems, and repairing, fabricating, modifying or installing new equipment. These functions must be provided as "chargeback" services.

In practice, the responsibilities of plant operation have been carried out by:

- Providing services necessary to keep facilities operational, e.g., repairing and monitoring the heating/cooling, electrical and plumbing systems, and the building components;

- Administering a Preventive/Programmed Maintenance System designed to protect the plant, enhance the learning environment, and extend the useful life of buildings and facilities;

- Providing custodial services and maintaining an acceptable level of cleaning;

- Providing grounds services to maintain turf, trees and flora around roads, paths, buildings and parking lots, and athletic fields;

- Developing and managing energy conservation projects designed to reduce energy consumption;

- Providing services such as key control, motor pool management, project planning, estimating and project design; and

- Providing contract management for capital outlay and special repair projects.

Plant operations is also deeply involved in environmental health and safety efforts, such as asbestos abatement, PCB removal, and carcinogen control.

The new policy divides all of the work done by plant operations into two categories - maintenance and non-maintenance. Maintenance activities can be broadly subdivided into the four specific sub-categories defined below:

- Preventive maintenance is a pattern of periodic, repetitive tasks specified for and applied to discrete parts of buildings, equipment, and systems, scheduled to be performed at intervals of less than one year.

- Programmed maintenance is a plan to refurbish or replace parts of buildings, equipment, and systems as they wear out or in a cycle in excess of one year, e.g., carpets, window coverings, painting, etc.

- Emergency maintenance is the response to a condition or problem whose correction is time critical and urgent.

- Corrective maintenance is usually the repair, adjustment, or replacement of a device or component at a time convenient to the organization.

In general, plant operations had possessed a personality similar to any highly bureaucratic organization. Plant operations:

- Was reactive rather than proactive to needs and processes;
- Undertook little or no planning in establishing directions;
- Recognized long traditions of behavior and procedures;
- Maintained mostly manual records, if at all;
- Consisted of highly discrete functions - purchasing, material control, estimating, planning, etc.;
- Emphasized technical leadership instead of professional management;
- Fostered the informal or underground network in identifying assignments and establishing priorities; and finally,
- Developed unevenly and sporadically from campus to campus.

Plant operations suffered benign neglect. It was treated as a third class citizen, and its resources were unhesitatingly exploited by ambitious campus presidents who needed to support non-funded activities such as Health and Safety Officers, Affirmative Action Directors, and Athletic Coaches.

FORCES FOR CHANGE

For the past five years within the CSU, plant operations has been undergoing massive change. During this period, there have been a series of developments which, as a major cost center within the CSU, have raised intense interest among the members of the State Legislature as well as those in the control agencies of the executive branch. Several rounds of reductions in new construction budgets, personnel, and operating budgets, as well as the advent of collective bargaining, have given new visibility to the accelerating deterioration of the physical facilities of the CSU. Some significant forces for change have been:

* Emphasis on maintenance and away from construction;
* Introduction of the chargeback policy on many services which the institutions need and have not paid for in the past;
* Aging buildings and other facilities;
* Construction of high-rise buildings;
* Requirements for handicapped access;

* Environmental health and safety requirements, such as: PCB removal, asbestos removal, and control of carcinogens;

* Cuts in the labor force;

* Introduction of new instructional technology,

* Energy management;

* Collective bargaining;

* Introduction of the Work Control Concept;

* The edict to install a preventive/programmed maintenance concept;

* Increased requirement for accountability;

The introduction of the Work Control Concept has required the creation of a Work Order Control Center on each campus. The activation of this structure before the implementation of the automated system had a major impact upon the success of the new computer-based application. The Work Control Center focuses all communications between the campus community and plant operations through a single point. All incoming telephone calls, including emergencies, and scheduled service requests as well as work assignments are channeled through this one central point. Confusion, duplication and inconsistencies can be avoided. At the command of this operation is the Work Control Center Coordinator who gives considerable attention to all the functions within plant operations.

Also prior to any attempt to automate the maintenance activities, pressure was being exerted upon the campus not to redirect funds for construction projects, e.g., moving doors, installing power receptacles, erecting walls, etc. Of course, billing customers for such services received required a new consciousness toward collecting and maintaining accurate, complete records on the labor, materials and overhead assigned to a project. More precise estimating of costs and scheduling of work became a requisite. And, naturally, variance reporting was a by-product of information demanded by the "customer".

Another edict issued by the auditors was the requirement that access to materials, supplies, and equipment found in the warehouse be controlled. Where there were warehouses, entry was largely as needed and there developed a strong suspicion that inventories were vanishing. The order to more closely control inventories included the practice of applying such principles as reorder points, frequency counts, and continuous inventory counting.

The controls suggested by the auditors were labor intensive and produced vast quantities of data. Manual efforts to conform to these new procedures overwhelmed existing plant operations resources, and some of the more determined managers looked to automated computer-based solutions. However, it did not make sense to reinvent the solution 19 times.

VEHICLES FOR CHANGE

A number of managers within the plant operations offices became inspired and enthusiastic about a jointly-developed, systemwide solution to their needs to upgrade their maintenance functions. What further enhanced the opportunity to advance the environment into a sophisticated computer-based solution were other factors which had already arrived at a mature state. These are briefly described below:

* Professionally Developed Turn-key Systems. That there existed a large number of maintenance applications on the market gave creditability to such a solution. Conceived and developed by engineering firms, these systems could be customized to meet unique operating requirements.

* Reduced Costs of Hardware. Most solutions were based on the smaller mini-processors, allowing turn-key systems to be affordable.

* Ease of Operation. The new systems allowed plant operations to install and operate the equipment with a minimum of expert, technical support.

* Fourth Generation Environment. The users could identify their needs and make minor extensions and improvements in information reporting requirements. Users could control their own destiny (or at least believe they could).

* On-line Access to Information. Updating and reporting requirements necessitated a real-time environment. Immediate response to the real world was essential.

* Organization Structure. The Work Center Concept, when adopted, produced a highly structured, well-defined and documented organization. Few changes in the chain of command and interaction among personnel were required to install the system.

Most important, there was a genuine commitment at the corporate level of administration. The Vice Chancellor, as well as most campus vice presidents, were behind the project.

PLANNING FOR CHANGE

Already in place was a special committee with broad-based representation from each campus' plant operations organization. Called the Plant Operations Project Group, this committee became the Maintenance Management System (MMS) Steering Committee and status reports were received during its periodic meetings. The Technical Team consisted of a highly articulate member from a campus plant operations; a senior member from among the campuses' data processing directors who was also named the project

leader; and a plant operations specialist from the Chancellor's Office. Subsequently, after award of the bid, the Technical Team was augmented with an individual who was knowledgeable of organization behavior, a brilliant addition whose experience guided the project through many land mines. The most critical addition to the project was the assignment of a member of the Vice Chancellor's staff to the team. This individual cut through bureaucratic red tape whenever any of the numerous obstacles of the project began to raise serious opposition to the project. Budget issues were always a concern and negotiations among the campuses, the Chancellor's Office, and state agencies required intervention at the highest levels of administration.

The first task of the Technical Team was a Needs Analysis Survey. A twenty page survey instrument was developed, and all 19 campuses responded - quite an achievement! After a systemwide analysis of the data was made, a preliminary conceptual model was developed of the proposed maintenance system. The related procedures and tasks were consolidated into several modular subsystems. A set of detailed specifications was developed and, along with a general description of the conceptual model, was transformed into a Request for Information (RFI). The RFI was sent to over 60 potential vendors, and received 20 responses. An evaluation of the responses allowed the Technical Team to fine-tune and adjust the rough points of the conceptual model so that it more nearly reflected the actual requirements. The Technical Team did not want to rewrite the new system's programs.

Before the State would approve the project for inclusion in the budgetary process, a feasibility study had to be developed. The study contained a detailed analysis of minute tasks and projected associated benefits and savings that could be realized through an automated system. It was impossible as well as unacceptable to develop savings based on long-term benefits, such as extending the life of equipment and providing more complete preventive maintenance. The absence of any existing historical data covering the down-time of equipment, the replacement of machines, unmet backlogs, etc. eliminated any frame of reference from which improvements of the new system might be compared. Definitely the control agencies challenged the integrity and creativity of the authors of the feasibility study.

A natural extension of the previous efforts was the Request for Proposal (RFP). It contained the final version of detailed specifications along with administrative requirements of the procurement. Points were assigned to each of the features of the application in order to weigh their relative importance. Fifteen bid responses were received. The three vendors with the highest point-to-cost ratios were selected for a validation demonstration. After each system was scrutinized carefully, the award of the contract was made to the overall lowest bidder.

With the arrival of the behaviorist, more attention was directed toward training, documentation, and user manuals. Few vendors gave this aspect of their products adequate, if any, thought. And certainly, the user materials were not oriented to customers in higher education. Hence, additional negotiations were required to bring the training aspect and manuals up to a standard appropriate for every employee who would be involved in the new Maintenance Management System.

THE POST IMPLEMENTATION AND EVALUATION REPORT

One year after the installation of the hardware, the Technical Team visited each campus to determine the degree to which each campus was achieving the performance objectives identified in the feasibility study. Also, there was interest in ascertaining what secondary effects might be realized through MMS.

The survey instrument was divided into six major modules:

** The Installation Process

** Influence on Management of Plant Operations

** Program Results

** Organization Impact

** Cost Control Factors

** Long Term Support Requirements

The data collected from the above survey suggest the following critical success factors:

- Management Commitment. Those campuses without a strong management interest fell significantly behind those that did. In some cases, the management was changed.

- Campus Redirected Resources. Those campuses which chose to upgrade their hardware immediately and add additional personnel in the Work Control Center advanced their progress significantly beyond those that didn't.

- Product Champion. The identification of a key promoter to champion the cause for the change was evident on many campuses. This person usually worked excessive hours forcing the system to perform well and absorbing much of the pain associated with new implementations.

- Technical Support for the Computer Center. Many plant operation units sought and received technical assistance from their local computing facilities. The presence of some vendors' equipment in the Computer Center meant that operating characteristics were identical.

- Site Visits. Prior to installation, the Technical Team spent two days on each campus reviewing conditions and sensitizing the management to important issues.

- Implementation Plan. This document communicated the entire scenario of the project to the campuses. Broad participation from campuses in the creation of the plan insured acceptance of the plan.

- Training. Major emphasis was placed on a thorough, extensive training program, easy-to-read user manuals, and complete operational documentation.

- Hotline. Campuses called the vendor's technical assistance service and received quick, responsive answers.

- Post Implementation Survey. Campuses were motivated to demonstrate their progress with MMS. A spirit of competition prevailed among many managers.

During interviews with the plant operations directors, they report that they have noticed:

* Improvements in identifying and tracking chargeback work;

* Increased productivity;

* Better labor accounting;

* Tighter material control;

* Closer inventory control;

* Improved scheduling and management of the work;

* No loss of work orders;

* Higher work order completions rates;

* Better coordination of the trades;

* Improved accountability of supervisors;

* Development of a comprehensive inventory of maintained items;

* Documentation of equipment performances;

* Improved relations with clients;

* Higher visibility of problems;

* Improved availability of material as needed;

On the other hand many customers report increased effectiveness of plant operations in such matters as:

Better scheduling of projects;

Improved closure on work orders;

Better estimates on chargeback projects;

More rapid response to service requests; and

Better planning, scheduling and execution of the work.

In summary, the new Maintenance Management System has been a stimulus for:

* The creation of new policies;
* The reorganization of the central administration;
* Classifying and documenting procedures;
* Developing improved standards of performance;
* Improving the accuracy of accounting for labor and materials;
* Tighter scheduling and tracking of work flows; and
* Controlling and maintaining warehouse inventories.

In conclusion, MMS has been successful far beyond the expectations of its originators; it has raised the self esteem and personal confidence of those closely identified with the project.

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'HELLO, I'M NOT AT MY DESK RIGHT NOW..."

A Whimsical Look at the Use and Misuse of Voice Messaging and Menu Systems

The implementation of new voice communication technology prior to having a carefully thought out plan can introduce a variety of new and often frustrating issues to the corporate and public users of the system. Voice messaging systems and automated call routing systems are powerful tools which may enhance user productivity and expedite call processing. However, callers may get "lost in loops" and find themselves in "voice mail jail" if the system features are not properly implemented. This presentation explores this new enhanced call processing technology and offers some tips on what makes some implementations effective while others become public relation disasters.

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September 1988

'HELLO, I'M NOT AT MY DESK RIGHT NOW..."

A Whimsical Look at the Use and Misuse of Voice Messaging and Menu Systems

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Did you hear about the former boss who tried to send a very personal romantic voice mail message to his sweetheart in another office and sent it to the department group distribution list by mistake? Or about the new way unmarried Yuppie couples refer to their cohabitation arrangement as being in "phone message synch"...?

The implementation of new voice communication technology prior to having a carefully thought out plan can introduce a variety of new and often frustrating issues to the corporate and public users of the system. Voice messaging systems and automated call routing systems are powerful tools which may enhance user productivity and expedite call processing. However, callers may get "lost in loops" and find themselves in "voice mail jail" if the system features are not properly implemented. This presentation explores this new enhanced call processing technology and offers some tips on what makes some implementations effective while others become public relation disasters.

First, we'll take a look at voice mail including its purpose, features, uses and misuses as well as what's involved in the administration of a system. Then we'll examine automated call routing systems which are also known as "automated attendant" or "enhanced call processing" systems.

The noble purposes of voice mail systems include avoiding telephone tag, providing information to callers, and increasing productivity. Telephone tag can be avoided by leaving detailed messages rather than call-me-back messages. In this way, one can actually conduct business activities without having to have a meeting or a two-way conversation with the other party. It goes without saying that highly confidential messages should not be entrusted to voice mail. Information, such as the time when you will return from a trip, may be provided to callers as a courtesy in your greeting announcement. Productivity gains result from being able to receive and act on messages at your convenience.

Other features supporting productivity include group distribution lists allowing, for example, a secretary to remind several people of a meeting by recording one message and entering the code for the group distribution. Our institution recently used the broadcast announcement feature to simultaneously notify 1800 voice mail users across campus about the selection of the new campus president. Having off-campus access to one's voice mail messages is a feature which many users have found productive. Some systems even offer a return receipting feature so that the message sender is notified that the message was heard by someone with access to the receiver's mail box. This is one way to avoid "executive lying" (e.g., "I never got your message").

So you've decided to give voice mail technology a try. Here are some tips on system acquisition and administration. System capacity is rated in terms of storage hours; it's really only a digital mass storage device. There are usually at least three primary parameters which the system administrator may adjust. These are the length of each message, the number of messages an individual may have stored at any time, and the number of days for which a message will be retained. Sets of these parameters may be grouped together into classes with similar characteristics. Our campus has a class called faculty that permits up to 50 messages of up to 2 minutes each which are retained for up to 17 days. To determine the required system capacity, multiply the user parameters for each class by the number of users in that class. This formula leads to a calculated disk storage far in excess of actual requirements because disk space is dynamically allocated. Over-subscription ratios of twenty or thirty to one are not uncommon based on the general statistic that the average user will utilize less than four minutes of storage at any one time.

Campus politics may come into play in determining who gets a voice mail box. Will the custodians be insulted if they don't get a mail box? Is any employee a second class citizen if he or she is not allocated this resource? We found that part-time faculty who often have limited, if any, office hours use this system to communicate with students who otherwise would have to wait several days until the next class meeting. Our recommendation is to give a voice mail account to every individual and office that has a telephone.

Watch out for hackers (yes...HACKERS)! The diabolical sophomore syndrome is present. You are not paranoid. They are out there trying to gain access to and control your system. An article in the September 12, 1988 issue of Network World stated: "A wholesale grocer (in Los Angeles) recently fell victim to a small band of hackers that commandeered the firm's voice-messaging system and used it to run prostitution rings and pass information about drugs." At our campus, faculty voice mail boxes were pre-initialized one month prior to the return of faculty for the fall semester. The initial password, to make login easy, was set to the same number as the four digit telephone extension. Clever! Right? When the faculty arrived and tried to open their voice mail box, they found that Zorro and Darth Vader owned their accounts. Our recommendation is to use no less than six digit passwords and change them periodically.

If you are sold on voice mail, remember that there will be some who are not. Voice mail is a tool, like campus mail, that may or may not be appropriate for every situation. Once our Vice President learned that many phones in the Accounts Payable office had been forwarded to voice mail and vendors wanting to talk to a human about outstanding invoices were not impressed, he decided that was not an appropriate use of this technology. When the Executive Assistant to the President needed to talk to a Dean about the conduct of a faculty member , he felt uncomfortable leaving a "detailed message." Our recommendation is to be prepared to remind those who complain about the technology that they simply should not make use of it.

Automated attendant or call routing capability is sometimes packaged with voice mail systems. It is also sold as a separate enhancement to your voice communication system. The purposes of call routing systems include providing information to the public and call expediting. In theory, more calls can be processed without additional operators. This technology can actually provide a disservice to callers if not properly implemented.

In a complex organization it is tempting to try to have each unit referenced in the main menu or the sub-menus of a call routing system. However, from the perspective of a caller who may not be familiar with your organization, this may appear as a great maze with few clues as to the way out. For example, a high school graduate calling to check on his or her admission status may not be sufficiently familiar with the language of higher education to know whether to press "1" for undergraduate or "2" for graduate admissions. After all, the person did graduate from high school. Similarly, does one calling for information really know the difference between the Counseling Center and the Advising Center? There is a new chant emerging across the nation that cries out: "Let me talk to a real person."

On the other hand, if a large percentage of calls to the main switchboard request either the admissions office or directions to campus, then one has the perfect requirements for a simple call routing application menu with those two options plus a live operator default. The admissions option could then have sub-menus with option "1" being a recorded announcement of deadlines, financial aid procedures, housing procedures. etc. The press "2" directions-to-campus option could transfer to a recording which could also include information about current events on campus. The live operator default could be routed to an automatic call sequencer which advises the caller that his or her call will be processed in the order received. Our recommendation is to have no more than three or four main menu options and with each having no more than one sub-menu. Each menu, main or sub, must offer the caller an option to connect to a live person.

Looping or getting trapped in the voice mail jail is a potential problem for your callers. Even though you think you have a perfect menu branching design, an unplanned loop may occur. In the scenario above, if the admissions real person in the sub-menu is already on a call, where does the call router transfer to? If it goes back to the main menu, you've lied to the caller who's expecting a live person. Similarly, if that admissions clerk is on break, does the transfer go to the clerk's voice mail account which again is not a live person?

If your PBX is from one vendor, your call router from another, and your call sequencers from yet another vendor, you may experience some hardware/software incompatibilities that will cause your perfect call routing algorithm to behave strangely. For example, our call sequencer does not truly release a call which an operator has transferred but keeps that particular sequencer trunk tied up until the conversation is terminated. As a result, we had to acquire a larger capacity sequencer. A "feature" of our call router is that it will not give up if it can't complete a transfer. The result is that a caller may be returned to the main menu if the option selected is not available to respond.

In summary, we have highlighted some strengths and weaknesses of voice mail and call routing systems. This technology provides some wonderful opportunities for your organization but has some potential threats. We hope the recommendations for do's and don'ts will be of assistance. The final advice is to start out slowly with planned phases. We tried to implement a new voice switch, a new voice mail system, a new prefix, a new call routing system with a complex menu, and a new campus data backbone network at the same time. Needless to say, we confused and upset a lot of folks. The lesson, to paraphrase a wine commercial, is that one "should serve no technology before its time."

This session is intended to be a sharing of information activity. We would now like to hear about experiences with this technology from other institutions.

Going to Extremes: A Statewide System SIS Implementation During Funding and Structure Instability

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ABSTRACT

This paper focuses on the radical restructuring of Alaska's public higher education system brought on by the State of Alaska's 1986 economic collapse which occurred in the middle of implementing a statewide student information system. The restructuring created three multi-campus institutions from a system originally comprised of three universities and eleven community colleges over a two-year period. Coordinating a major statewide information system development effort initially designed for an education system comprised of established and finacially secure four-year universities, community colleges, and an array of rural and distance delivery instructional components is a challenge itself most states would find difficult to undertake. Compound it by simultaneously altering the University system structure by merging open-door admissions community colleges with four-year traditional universities, redesigning core curriculum and course numbering schemes on a global scale, rewriting all academic rules, absorbing a 24% general fund budget reduction (33% if state student loan funding is included), adjusting to the elimination of two out of five admissions and records offices and their accompanying staffs, and going through two iterations of student record conversions before the final system structure stabilizes. Taken together, the constraints encountered by the student information system project at the University of Alaska prompted the development of a non-traditional approach toward involving users from each campus in the system in all aspects of the systems development effort. Embracing this user perspective toward project management enhanced both the system design and campus commitment toward a successful development effort, established effective project team communication, and helped reduce the risk that non-data-processing tasks would end up on the project's critical time path and result in cost overuns. Now, fully one year after bringing SIS online, the approach taken by the project team continues to enable a smoother evolution of SIS as changes in the University organizational structure stabilize.

INTRODUCTION

In late 1985 and early 1986, world oil prices collapsed. Wellhead prices for oil fell from $28 per barrel in January, 1986, to below $10 per barrel in August, 1986. In a short period of time, the State of Alaska, whose budget was more than 86% dependent upon the price of oil, saw its total state revenues drop by more than one-third. The governor and state legislature were forced to curtail state spending several times. For Alaska's statewide system of higher education, falling state oil revenues brought budget cuts -- four percent in FY86, ten percent at the beginning of FY87, another ten percent in the first month of FY87, and another initially proposed fifteen percent reduction scheduled for FY88.

Spurred by real and proposed budget cuts, in December of1986 the University of Alaska Board of Regents approved a massive restructuring of Alaska's statewide system of higher education. The restructuring plan called for a merger of eleven community colleges with three universities into three multi-campus institutions. The plan realigned statewide programs in vocational-technical education, fisheries and ocean sciences, international business, and rural higher educational delivery. It called for the merger of a unionized community college teaching faculty with a non-unionized University faculty. The plan anticipated termination of nearly one hundred administrators and an additional five percent cut in system costs without significant impact on program delivery. The plan was controversial. It spawned litigation, legislation, arbitration, and a 1988 voter initiative. Now, two years later, the major elements of restructuring are complete.

This paper will present how the University of Alaska System addressed these extreme and sudden reductions in state appropriations and how this affected the implementation of an online student information system (SIS) which was just eight-months away from going live when the crisis hit. It will trace the factors which required that restructuring be considered, document the restructuring decision-making process, detail the process of carrying out the restructuring plan, and assess the impact on the SIS to date.

Factors Leading to Restructuring

For twenty years, the fortunes of the State of Alaska have been tied to those of the OPEC oil-producing countries. As one of the United States' most significant petroleum-producing regions, Alaska benefited from the 1973 and 1979 increases in oil prices. Nearly all oil production in Alaska occurred on state-owned land, yielding royalties, and all production was subject to severence and income taxes. The value of oil production so overwhelmed other economic activity that the state became highly dependent upon petroleum income as a source of state revenues.

Among the principal beneficiaries of new state wealth were the public education system and the statewide system of higher education -- the University of Alaska. A single University in 1970 , it grew to two, then three universities while the number of community colleges in the system grew from two in 1970 to eleven by 1979. In 1980, the University system began its first $100 million state-funded budget, which increased to $168 million by fiscal year 1985.

In 1980, the system was organized into six major administrative units:

- The University of Alaska-Fairbanks (UAF), the original University, with strengths in natural sciences, a strong research program in life sciences, marine sciences and geophysics, the only doctoral programs in the state, and a residence-based student body.
- The University of Alaska-Anchorage (UAA), a young comprehensive urban University with emerging graduate programs and new residential housing, struggling to overcome a "little brother" image to UAF.

- The University of Alaska-Juneau (UAJ), a small four-year college, formed by the 1978 merger of a four-year institution and a community college.
- Anchorage Community College (ACC), the state's largest community college with strong vocational and academic transfer programs and a student population of 10,000.
- Community Colleges, Rural Education and Extension (CCREE), a mini-system within a system based in Anchorage, including ten community colleges ranging in size from Chukchi Community College in Kotzebue (60 FTE) to Tanana Valley Community College in Fairbanks (750 FTE), rural education centers in a dozen rural villages, and the Cooperative Extension Service.
- Statewide Programs and Services, including the system administration offices, the Sea Grant College Program, and the University computer network.

By early 1985, the oil bubble began to shrink. Oil prices softened. The University of Alaska Board of Regents, foreseeing a period of little or no growth, called upon the administration to develop a new six year plan based on reduced expectations. The 1985 Alaska legislative session saw the first real reduction in state funding for higher education -- the University system was forced to make $7 million in reductions to pay for a $7 million cost-of-living increase for University employees. The budget stood at $168 million.

Over the fall of 1985 the University began the process of belt-tightening, shaving budgets wherever possible. While budget-cutting is always painful, most observers saw enough slack in the budget to cut expenses without major program effects. By December, however, oil prices began falling more sharply. The University's President created a Budget Flexibility Task Force of University administrators to look for further belt-tightening opportunities. In January, 1986, the tumble in oil prices became a free fall. By March, revenue projections were down more than 25 percent. Alaska Governor Bill Sheffield called for a freeze on state hiring and other measures designed to save money for the remainder of FY86. The University followed suit, targeting a $2 million reduction in spending (five percent of remaining funds) for the final three months of the fiscal year.

The budget for fiscal year 1987 would certainly be worse. The Governor called upon the University to reduce spending by $15 million, or nine percent; after some wrangling the legislature approved the cut. The University responded with a plan which called for reductions in out-of-state travel, elimination of all equipment purchases, a reduction in pension benefits for staff, a tuition increase, limited program reductions, and the elimination of statewide programs in nursing, a phase-out of the WAMI medical education program, and significant reductions in institutional support and academic support personnel. The plan called for elimination of 250 jobs, 175 of which were filled at the beginning of the year, and the closing of two of five admissions and records offices in the system. The University entered the new fiscal year under difficult financial conditions, with a general fund budget of $153 million.

fter the Alaska Legislature adjourned, state revenues fell further. On July 17, 1986, the Governor announced a general budget rescission for state agencies, giving the University a fifteen percent, or $23 million reduction. The President notified the system chancellors that he was forming a Restructuring Team to "gather information needed for refining the statewide system and campus missions based on the strengths of each campus and the elements which permit it to be of special value to the region that is served."

The Restructuring Decision-Making Process

In early August, the Governor changed the rescission target to $15.3 million. The University President reported to the University community on the planned response to the Governor's request. After meeting with the five chancellors, the President would recommend to the Board of Regents a package which included:

- $9 million in reductions to teaching, research and service programs
- a declaration of financial exigency, allowing the University to reduce compensation for

non-represented employees by $8 million, including reductions in teaching contract lengths
- increases in miscellaneous fees and parking charges
- restructuring of the system to "make it a smaller institution, offering fewer services to a more limited range of citizens, but retaining its quality and reputation, and preserving a basic structure on which it can build when the state's economic situation improves."

The Board of Regents balked at the declaration of exigency, believing it would produce permanent harm to the University system. After an emergency meeting with the governor, the regents agreed to lapse $6 million in unspent capital appropriations, with a commensurate reduction in the budget rescission. Staff salaries were frozen and benefits were reduced. The agreement anticipated further reductions in the following fiscal year.

On October 31, 1986, the President unveiled his proposal to the Board of Regents. It called for three multi-campus universities, which would merge the open-access community colleges with traditional University institutions. The new structure would have the following features:

- In Southeast Alaska, the University of Alaska-Juneau and Ketchikan and Islands Community Colleges would be merged into an undergraduate college with a regional mission offering developmental courses and associate and bachelor degrees, providing graduate programs by extension from Anchorage and Fairbanks, and receiving vocational-technical programs from Anchorage.
- In Northern Alaska, the University of Alaska-Fairbanks which provided undergraduate and graduate programs would merge with Tanana Valley Community College. As part of this institution, a new rural college would merge the rural community colleges (Chukchi, Kodiak, Kuskokwim, Northwest, and Prince William Sound Community Colleges) and the extension centers with responsibility for vocational-technical programs, associate and bachelor degree programs. The Cooperative Extension Service would be associated with UAF colleges.
- In Southcentral Alaska, the University of Alaska-Anchorage and Anchorage Community College would merge. The Matanuska-Susitna and Kenai Peninsula Community Colleges would merge with this unit, offering instruction at the associate, baccalaureate and masters level. A new statewide vocational-technical unit would be formed from the Anchorage Community College program, offering elements of the program throughout the state.
- Once the new institutions were well established, the Statewide Administration would play a narrower and more policy-oriented role.
- A new statewide fisheries and marine science faculty would be created, merging programs throughout the state under the new northern institution. A similar faculty unit for international business would be based at the southcentral institution, and health and medical education and research would be centered at the Anchorage campus.

The public response was immediate and intense. Community college councils, the unionized community college faculty, and concerned citizens attacked the President and his plan. At public hearings throughout the state, hundreds of people criticized portions or all of the plan. A coalition of opponents, the Community College Coalition of Alaska, was formed. Opponents saw the plan as denying the mission of community colleges, changing the nature of the college commitment to students, removing the community service role of the local administrations, abridging local control and autonomy, and possibly breaking the community college teachers' union.

In December, the Board of Regents modified the plan, shifting Kodiak and Prince William Sound Community Colleges to the new Southcentral Institution and making other programmatic changes, then approved the plan and new structure. Significant changes included plans for allowing communities which

provide a traditional community college funding base to keep local control, plans for assuring the community college mission was maintained, realignment of some extended colleges, and priority given to remedial/developmental and core lower division courses and programs, and bachelors' level courses and programs at the current community college locations. In Anchorage and Fairbanks, new colleges were created within the universities to provide continuing education, vocational training, and certain other functions of the former community colleges. The regents asked the administration to prepare regular reports on programs at each community which previously had a community college. Several major policy issues were identified at the regents' hearings, which became recurrent themes during the ensuing months. These included:

- Protection of the community college mission
- Integration of the unionized community college teachers with the non-union University faculty
- Integration of programs between community colleges and universities
- Maintenance of accreditation of programs and institutions
- Maintenance of community-based advisory structures

The Restructuring Process

The restructuring implementation process was to include three phases: (1) consulting groups, consisting of University and community college administrators and staff and representatives of external constituencies, would draft solutions and responses to major issues, to be approved by the chancellors and regents, (2) institutional restructuring advisory committees would develop detailed plans, creating special task forces as necessary, (3) systemwide task forces on rural program delivery, fisheries and ocean sciences, and vocational-technical education would plan organizations for these new units.

While overseeing this implementation process, however, the President's Restructuring Team found that external battles occupied much of its time. When the legislature convened in January, 1987, bills were introduced to separate the community college system from the University. Lawsuits were filed by a school district and by the Community College Coalition. By March, the Coalition announced an initiative campaign designed to separate the community colleges.

At each meeting of the Board of Regents, further refinements were made in the overall restructuring plan, and specific problems were addressed. The regents approved a policy allowing communities which provided through local funding and tuition at least 1/3 of the local campus budget to maintain a semi-independent community college, with a local administration much like the institutions which existed prior to restructuring. The only community which qualified as of 1987 determined it would keep Prince William Sound Community College under this policy.

The legislature adjourned without action on the separation bills, but the State House passed a resolution asking for reconsideration of the restructuring plan. The University budget was approved at $137 million, with an additional $4 million in restructuring transition funds approved from University interest income. The budget structure followed the lines of the restructuring plan, calling for $6 million in savings from restructuring, $6 million from permanent program reductions, $8 million from compensation reductions, and restoration of $9 million of the emergency reductions made in the previous year. The budget included nearly 50 "legislative intent" statements, asking for protection of the community college mission, for reporting on all events related to restructuring, and creating a special interim committee to oversee and report to the 1988 legislature on the restructuring process.

In May and June, 1987, the regents tackled what had become the most significant problem -- merging of the two faculties. Under the terms of the collective bargaining contract, the University could not force union members to become part of the University faculty. It could offer transfer opportunities, and management had the right to create or eliminate community colleges. The University offered to bargain over the effects of restructuring, but the union insisted on bargaining over the restructuring decision. Some talks were held, but no bargaining commenced. In early June, the regents voted to offer transfer

opportunities to all unionized teachers. The offer generated opposition from both community college and University faculty.

The union filed a grievance the next day, alleging the University had unilaterally altered a major policy by eliminating the entire community college system, thereby negating all provisions of the collective bargaining agreement. The University denied the grievance, and it was submitted to arbitration. All but one community college faculty member signed the transfer papers, although many added protest notes. The community college faculty also filed an unfair labor practice charge against the University, alleging willful refusal to negotiate anything but "effects" bargaining, changing salaries and workload without bargaining, changing working conditions, discrimination against union members, failure to present the entire plan to the union, conducting individual bargaining with union members by offering individual reassignments, refusal to recognize the union as the elected representative of employees, and "anti-union animus" by the president. The unfair labor practice decision process was held in abeyance, pending the arbitrator's decision on the union's grievance.

The regents also adopted policies governing the merger of institutions and reduction of institutional support positions in the new institutions. Policies were created to ensure that where several individuals held similar jobs in the old institutions, each would be considered for the job in the new institutions. Those not selected would be laid off, with certain rehire rights. Of the five SIS campus implementation coordiantors, only one remained employed at the University after this phase of the restructuring.

On July 1, 1987 the new institutions came into existence. The process of combining administrations began. It was most severe in Anchorage, where the three old administrations of the University of Alaska-Anchorage, Anchorage Community College, and the Community Colleges, Rural Education and Extension division were to be merged under a single chancellor. The process for merging administrations provided for notice of "affected position" to all persons holding similar jobs, determination of the best qualified from among those affected, and layoff notices to those not chosen. Systemwide, nearly 100 positions were eliminated, including two chancellors, five vice chancellors, eight deans, 19 directors or campus presidents, and a host of coordinators, managers, other administrators, and clerical personnel.

The legislature convened in January, facing an initiative and separation legislation brought forward by the Community College Coalition. In February, the University won a major victory when the grievance arbitrator ruled in the university's favor, stating the restructuring was a "legitimate and proper" response by the University to its funding circumstances. In May, the Superior Court judge hearing the initiative lawsuit ruled in the university's favor on the appropriation question, removing the initiative from the fall ballot [no decision was made on the vagueness question]. An appeal to the Alaska Supreme Court reversed the lower court's decision, and this past November, 1988 the ballot measure to separate the community colleges from the University System was rejected by the voters.

Positive outcomes of restructuring for students are significant. For students in Anchorage, there is now one SIS registration process for all students, rather than separate processes for Anchorage Community College and the University of Alaska Anchorage. Movement from branch campuses to the main campuses in Juneau, Anchorage, and Fairbanks is now a within-institution transfer, rather than a transfer to a new institution. A simplified course numbering scheme implemented with SIS makes understanding of courses and programs significantly easier for both students and faculty. Students now have a single tuition structure within Anchorage and Fairbanks, rather than a dual community college - University tuition structure. Academic advisement should improve, as advisors can deal with all courses taken by a student, rather than only courses taken at the advisors' separate institutions. Students at branch campuses and in rural Alaska have seen new benefits beginning this fall. Selected upper division and graduate courses are now offered at the branch campuses in addition to the vocational-technical and lower division courses formerly offered by the local community colleges. As demand warrants, full degree program sequences are likely to be offered in education, business and management. Cooperation among the rural colleges in the use of distance delivery technology will make courses formerly offered in only one community or

region available throughout rural Alaska, increasing student course choices.On the negative side, some non-traditional students believe that even with open door policies, institutions called universities are not as student-centered as community colleges and will thus provide less service to students.

For faculty, the results are mixed. Benefits include the bringing together of faculty that had been in a more isolated educational environment to form a more functional critical mass. A new governance structure increases the visibility and role of faculty in decision-making at the three new institutions, while continuing the faculty participation in the Statewide Assembly of University faculty and staff. Faculty in small departments and disciplines are gaining the benefits of a wider circle of peers. Some University faculty are concerned about the quality of instruction at the former community colleges, and are reluctant to accept transfers of students into baccalaureate programs. Some are worried about an erosion of quality at the upper division level, since the Board of Regents has placed such a large emphasis on maintenance of the community college mission. On the downside, the volume of issues facing faculty has increased dramatically. Development of new policies for evaluation, promotion and tenure has required increased faculty participation in committee meetings. Each department at each institution has faced problems of integrating curricula of two or more institutions, changing course content to allow simplified course numbering and unified course content descriptions. Many faculty members will be required to move, particularly in Anchorage where many departments are currently split between the old ACC campus and the old UAA campus. The strong committment of the traditional community college in Anchorage will continue to make it difficult to achieve full integration of programs and services, although many gains have been made.

The process took its toll on senior administrators. The survivors of the administrative combination in Anchorage were overwhelmed by the magnitude of changes planned, and had continuing difficulties effecting the merger of academic programs and faculty. In December, 1987, the Faculty Senate passed a vote of "no confidence" in the UAA chancellor. In February, 1988, the President reassigned the UAA chancellor, taking the assignment on himself. The system Provost also became a dual office-holder, taking the UAA academic leadership in addition to system academic leadership. Individual grievances and lawsuits multiplied.

HOW THE SIS IMPLEMENTATION TEAM ADAPTED TO THE RESTRUCTURING AND BUDGET REDUCTIONS

Develop A Project Organization That Involves Users - More Than Just Lip Service

Most administrative data processing development projects have historically revolved around the computer centers and have been directed by technical staff. The users, historically, were not brought into the basic system planning and design tasks by the data processing department. The University's SIS implementation team changed its system implementation philosophy by putting the general system design responsibility with the users. To accomplish this, the team adapted an organizational structure for project development efforts that included a management advisory committee (MAC), representatives from each major academic unit (MAU), a Training Team, and a Project Team. The MAC was comprised of top level administrators from each campus and were primarily the academic vice chancellors from throughout the system for SIS. The MAU committee members were the campus coordinators for the subject area being addressed by the project, from each of the units. The Training Team was composed of typical users from each of the units. Lastly, the Project Team itself was composed of members of the user community addressed by the project subject area, and included the Project Director who was ultimately responsible for the success or failure of the entire project.

The Student Information System project developed these relationships and moved ahead to implement a system recognizing the needs of users, balancing that with the technological capabilities that were available as solutions to user requirements. During this ***transition*** to project management by users, it

became important that users increasingly feel responsible for and direct the activities of the project. At the same time, it was important that data processing present a clear statement of alternatives and consequences from a technical standpoint so that decisions were made that considered all the trade-offs, both in system functionality and technical/cost impacts.

Clearly Define a Decision Making Process - Link Responsibility with Authority

Because of the varied nature of the University, the involvement of multiple campuses whose structures and relationships were changing, the decision making process could, and at times did, become complex and cumbersome. It was important to involve as many people as possible at the appropriate times to gain input and to assist in reaching a decision. However, decisions still had to be made and the old proverbial expression "being designed by a committee" could of had its consequences in this structure as much as any other if not managed appropriately. It remained extremely important that decisions be reached in a timely, straightforward manner if the project was to be completed on time. In the implementation of the SIS project at the University of Alaska, this process occasionally took longer than was desirable. It has been shown repeatedly throughout the implementation process that the time spent was worthwhile for the SIS project. It was necessary, however, to guard against letting it become a deterrent to getting the job done. This was accomplished by setting deadlines and using microcomputer project management tools such as PERT models and Gantt charts, so everyone knew who was dependent on whom. Within the organizational structure in place at UA, the actual decision making still had to be made at the Project Director level with approval through normal administrative channels. The multiplicity of decision groups the Project Team had to coordinate through indicates the degree to which this guaranteed user review.

COORDINATED DECISION GROUPS

Use State-of-the-Art Technology Effectively - Don't Skimp on User Training

When the University of Alaska embarked on upgrading its administrative computing capabilities, it issued an RFP for a Student Information System (SIS) and a Human Resource System (HRS) with associated hardware. The results of the RFP were the selection of Information Associates' SIS and HRS systems and an IBM 4381-2 mainframe. Also part of the process was to select programmer productivity tools and user support tools which would allow the users to perform much of their data processing functions without having to rely on the technical expertise of the programming staff. The RFP process resulted in the use of personal computers as workstations in order to provide a backup capability in the event of a disruption in the communications network or in the Control processing unit. Another purpose for the use of the micorocomputers is to provide a micro to mainframe connection that allows the downloading of information from the mainframe to microcomputers for data analysis.

As part of the software that was obtained, Cullinet's IDMS Management System was purchased, along with the associated products for development. These were used extensively for modifications as well as enhancements to the SIS package. Users have assumed responsibility for many of the ad hoc reports utilizing SAS, query languages, and other 4th generation tools that have been made available. As part of this, the project team put into place a support mechanism for training and assisting users in the application of these products.

Utilize Project Management Tools - The Secret Weapon in a Complex Environment

The key to making a successful transition from DP managed development projects to user managed projects is effective project management which integrates the strengths of both the data processing professional and the functional user. At the University of Alaska, this process began with compiling the administrative systems RFP where both programming and campus administrative staff collaborated. The user role was continually expanded from bid finalist site visitations through the identification and prioritization of software modifications. The manner in which software modifications were identified, used to construct implementation alternatives, and how project tasks were communicated serves as a good example of how project management techniques were used to integrate user and programmer.

In the spring of 1985, University of Alaska campus chancellors requested that the SIS project director develop a number of system implementation alternatives that would clearly present the trade-offs for each alternative in terms of functionality, required resources, and full system live dates. The major objective was to try to find areas which could be changed in order to allow an accelerated implementation schedule ahead of the originally estimated Fall1987 date.

A four-phase process was followed to facilitate the completion of the analysis in the timeframe provided:

- **Phase I - Identify SIS Modifications**
  In order to understand the software product the University had bought in relation to possible modifications that might be needed, the SIS Training Team comprised of campus users had to first complete SIS training. A number of meetings with campus, data center, and IA personnel subsequent to the end of the training period produced a list of two dozen required modifications to the base SIS system.
- **Phase II - Write Modification Specifications and Prioritize**
  A six question format, which incorporated both technical and functional questions, was developed to organize modification specifications in a comparative manner. The questions were: 1) what would we like to do, 2) what does the current system(s) do in this regard, or how do we handle it now, 3) what does IA's SIS currently have, 4) what alternatives do we have to satisfy the need for this modification, 5) what are the pro's and con's of each alternative, and 6) what is the recommended alternative, particularly in relation to cost, time, and manual impacts. MODS ID Teams, teams comprised of one campus user and one programmer, were assigned to every modification and were charged with compiling responses to each of the six questions for their modification. The most difficult aspect of the questions centered on the validity of the time estimates to complete any particular modification. No satisfactory numerical process was found superior to a best guess approach utilizing experienced users and programmers. All modification six-question write-ups were then studied by campus and central office representatives prior to being prioritized as being either absolutely necessary before turning the system on or not.
- **Phase III - Construct Multiple Implementation Scenarios**
  Four base scenarios were developed by varying the following variables: 1) whether one or multiple data bases would be used, 2) whether one or several independent copies of the SIS software would be used, 3) the manner in which campus differentiation would be handled, and 4) whether or not a phased approach to adding software modifications would be used. PERT (Program Evaluation and Review Technique) models were developed based on the

parameters imposed by each of the scenarios detailed as well as the modifications identified by campus users. A minimum number of set dates were used, thereby preventing the introduction of an excessive degree of slack, or unproductive wait time into each model. The models were used to refine tasks and task dependencies within the SIS development and design process and to calculate both pilot and full system implementation live dates.

- **Phase IV - Rank Each Scenario In Relation to Impact Variables**
  The final phase included comparing the relative rating of each scenario in relation to the following eleven key impact variables: 1) separation of campus data, 2) centralized reporting, 3) campus reporting, 4) software maintenance, 5) standard data definitions, 6) data redundancy, 7) computer center hardware, space, and staffing, 8) campus staffing needs, 9) interfacing to other system, 10) time to implement, and 11) additional cost. Campus chancellors picked the scenario which mandated the use of one data base and one software copy which included only the modifications identified as being high and medium priority. The scenario chosen showed a Fall 1987 full system implementation date.

In each phase, campus users were either involved in assessing or designing functional system characteristics and modifications or in the final decisions concerning the project implementation schedule. The approval of the modifications and their descriptions also served as a first step in delimiting functional and technical modification specifications needed by the DP center and consequently helped save considerable time on these and succeeding tasks.

Once this implementation milestone was completed, project management techniques were also used to plan, communicate, organize, monitor, test alternatives, and assess project progress. All PERT systems use a network to graphically portray the interrelationships among the tasks and milestones (key dates, meetings, events) of a project. The network representation of the project plan also shows all the precedence relationships regarding the order in which tasks must be performed .

For the SIS project, three levels of PERT detail were designed with different user levels in mind. The first level, the overall project schedule comprised of the highest aggregation of tasks, was targeted primarily for executive administrators, particularly the academic vice chancellors that comprised the SIS management advisory committee, and their need to know the major project events. Tasks at Level 1 were assigned principally to the campus, the data center, IA, or the SIS Office. Level 2 schedules detailed major project tasks by campus and individuals within the data center and the SIS Office. These schedules were targeted primarily to assist campus SIS coordinators and programming managers with planning for major task deadlines. The most detailed chart, Level 3, listed tasks by individual breakdowns and was coupled with a Gantt chart of assignment descriptions, earliest task start dates, latest task end dates, and estimated task durations. The tasklists were used to structure daily work assignments for users and programmers.

The use of PERT for constructing various levels of project planning, control, and scheduling for different degrees of user involvement has been invaluable for organizing the systems development project, testing alternative plans, revealing the overall dimensions and details of the plan, establishing well-understood management responsibilities, and identifying realistic expectations for the project. Taken together, the various levels of task descriptions functioned to provide a structured process in which to ensure maximum participation from and maximum communication to campus users around the state. The large investment in time and effort needed, paid off in the highest possible user - programmer integration. It also enabled managing the miriad of last minute changes due to restructuring as tests were being run on the first two pilot campuses to receive SIS.

SUMMARY AND CONCLUSIONS

The implementation of SIS at the University of Alaska has been enormously successful. This is in spite of the fact that the University experienced the most dramatic general funding reduction to an entire state public higher education system since World War II. This success has become even more apparent since

the system has gone live The system was implemented using the old University structure of 14 separate institutions. Immediately following implementation it was necessary to accommodate restructuring by combining the 14 institutions into three Universities that encompassed the functions of the prior Community Colleges and Rural Education.

In 1983 the University determined it would manage its own computing environment which had been previously done by a facilities management firm. New hardware, operating system, application software, productivity tools and staff were needed and training was started. A project management methodology was developed that required user involvement. The hardware and the software were installed and the projects underway when the bottom fell out. It was because of the wide spread support of users and management acceptance that the projects continued under such adverse conditions. Everyone was committed to see the systems implemented even though some knew their jobs would be eliminated shortly after the heroic efforts of implementation.

This paper as much as anything is an appreciation for the support of these individuals who were committed to that goal. Numerous extended hours were required. Management continued to support the project although funding for user help during implementation was non-existent.

The system's flexibility is indicative of a strong planning and support mechanism with everyone working together in spite of numerous differences. The most important aspect of systems development is the quality and commitment of its people, including management. Without strong project leadership it would have failed. Without users support and commitment it would have failed. Others may have succeeded without following the same process but the University of Alaska succeeded because of the people and the approach, under the most adverse conditions possible. The process followed was:

- **Develop A Project Organization That Involves Users - More Than Just Lip Service**
- **Clearly Define a Decision Making Process - Link Responsibility with Authority**
- **Use State-of-the-Art Technology Effectively - Don't Skimp on User Training**
- **Utilize Project Management Tools -The Secret Weapon in a Complex Environment**

SIS has proven to be a flexible and responsive system for meeting the University of Alaska needs. It has been adaptable as enhancements and additional functions are planned that will make it more useful in meeting the needs of the operational and management users of the system.

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